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RECENT PATENT DECISIONS.

In the course of some editorial remarks recently made under the above caption, we were led by the misinterpretation of a leading patent decision, into a misstatement as to the effect on an American inventor of the prior issue of a foreign patent for the same invention. As pointed out by Messrs. Hey & Parsons in another column, our construction is only true if the American inventor applies for a domestic patent on an invention he conceived and reduced to practice in a foreign country. In this instance his application will be barred by that of a foreign patentee, even though the former is the prior inventor, as the priority of the conception and reduction to practice of an invention made abroad will not be recognized as against the foreign patent of the other applicant. As the conditions referred to are rarely likely to exist, the principle quoted is one of little practical importance.

ELECTRICITY ON THE ELEVATED ROADS.

Quite a flurry was created last week by a positive announcement in the daily papers that the management of the Manhattan Elevated Railway system had entered into a contract with the Westinghouse Company for the equipment of its lines with electric power—the contract calling for an expenditure of $8,000,000. The following day as positive a contradiction of the report was published on the part of the Manhattan Company, but with the admission that while it had not yet been definitely decided to abandon steam power, that matter was being seriously considered, and that an examination is now under way with a view to finally determining the question. It was also denied that any preliminary arrangement had been entered into with the Westinghouse Company or that the rivals of that company would be discriminated against in the purchase of a prospective equipment. While the adoption of electricity is thus not yet absolutely determined upon, it seems very probable that the time is near at hand for that consummation.

MAGNETIC SYMBOLS AND UNITS.

Our English contemporary, the *Electrician*, in a slashing editorial which brings up remembrances of a time when such editorials in its columns were not the exception, refers to the use of the symbols recommended by the Committee on Units of the International Electrical Congress, and the employment of the names adopted by the American Institute of Electrical Engineers for the magnetic units, as an "anarchic tendency" which it refuses to countenance any further. If we may be pardoned for imputing a motive we would say that such a motive might be inferred from the remark that "block letters have become well established in this country, "where modern magnetism took its growth"; in other words, block letters are "English," the Congress symbols and A. I. E. E. names are foreign, and, therefore, "anarchic." The symbolism of Ampere, the father of magnetism, but a foreigner, must retire before the symbolism of—whom?—the father of modern magnetism—but an Englishman. Having thus asserted the time-honored principle of insularity, our contemporary proceeds to deface its editorial page with block letters in an attempt to prove that quantities expressing a flux density in air and in iron are as "distinct from each other as amperes are from volts!" Of course, the statement is not made in these words, but it is implied in the conclusion quoted. We also quote the following sentences (in which, however, we substitute the International Congress symbols), as a further illustration of the peculiar views of our contemporary with respect to magnetic quantities: "While $\mathfrak{B}$ is, perhaps, the magnetic quantity which can most easily be "measured under all circumstances, $\mathfrak{H}$, on the other hand, is, we "venture to think, the magnetic quantity which never has been "directly measured. It has been calculated from the magnetizing "current, and has been determined from the mechanical force

"exerted on magnets suspended in air, or from the density of lines "of force produced in air; but when we have to deal with a solid "magnetic medium, there is no means, direct or indirect, of deter- "mining $\mathfrak{H}$ at any particular point. All that is possible is to "measure the magnetizing current, and to calculate, by means of "assumptions, an average value of $\mathfrak{H}$." No stronger argument for the introduction of the term *gauss* could exist than the apparent deplorable misconception which so eminent a paper as the *Electrician* reveals concerning the relation between these two quantities. This looseness of thought and expression arises only from a want of a proper terminology, for as soon as proper units are introduced, such errors become impossible.

THE BERLINER OPINION.

We print elsewhere a synopsis of the belated opinion of the United States Circuit Court of Appeals, at Boston, in the Berliner case, which confirms the prediction made in these columns that the important issue with respect to the validity of the 1891 Berliner patent remains practically unaffected. To many the opinion will appear to possess an *ex parte* tone not usually associated with judicial utterances, but this may reasonably be ascribed to a probable tendency on the part of the legal mind to treat a decision after it has once been definitely determined, as if it were the subject of a brief. There are others, however, who do not consider the atmosphere of Boston a particularly healthy one in which to try a telephone case, and these may be inclined to place on this feature another construction than the one just suggested. It will be seen that the court showed little respect for the fraud issue, going so far as to say that the record rather suggests hostility on the part of the Patent Office toward the American Bell Company. Nor is it any more patient with the contention of the Government that it was incumbent upon the officials of that company to suggest methods to speed the microphone application, and that its possession of the fundamental Bell telephone patent added a duty in this respect. The court considers that a certain situation existed, unfavorable, perhaps, toward the public interest, but since the American Bell Company had done all that reasonable usage required, it is not subject to just criticism for accepting that situation as it found it. The unusual delay in the issue of the patent is ascribed to the Patent Office system and the first portion of the opinion concludes with a suggestion that Congress should pass the necessary legislation to correct this evil, which is declared to be beyond the reach of the judiciary. On the other issue of the suit—that the 1891 Berliner patent is void on the ground that the 1880 Berliner patent was granted for the same invention on the same application to the same inventor—it was decided that, as the grant of the later patent was within the lawful authority of the Commissioner of Patents, and no proof of fraud or gross error existing, the courts have no jurisdiction in the present action. With a remarkable exception that will be referred to later, this portion of the opinion is confined to arguments showing that the court is barred by statute from jurisdiction to determine the identity of the two patents, and it is expressly stated that the question of the validity of the later patent is left without prejudice, to be tested, if desired, by other methods provided by law, should it involve other individual or corporate rights. The exception above mentioned is a suggestion by the court that the case at bar does not, as contended by the Government, come under the Miller vs. Eagle decision; the suggestion seems to be an entirely gratuitous one, as it is made as a remark and then dismissed with the statement that, as the point was not made by the Bell Company the court cannot take cognizance of it. The point made in the suggestion is rather obscure, but apparently means that as the Eagle vs. Miller case involves two patents for the same invention issued to the same applicant, it does not fit the facts in the Berliner case, where the 1880 patent was issued to Berliner, and the 1891 patent to the American Bell Telephone Company as the assignee of Berliner. Assuming, however, that this is true, and that the Miller vs. Eagle case cannot be applied to the facts as presented by the Government in the present case, the issue thus presented is merely a technical one, and does not imply that the 1891 patent is valid. As we recently observed in these columns, the Miller vs. Eagle decision was of importance, not on account of establishing any new principle, but because it authoritatively interprets the old established principle that two patents cannot be issued for one and the same invention. If the Government has erred, as suggested, it has done so in attempting to correlate one set of facts to another set when the conditions of the two were different. The result will be that in future litigation, should the suggestion be considered to have weight, the test of validity will probably be directly applied, instead of indirectly, as in the present case. The refusal to permit the filing of an amendment to the bill, alleging collusion between the Bell and Drawbaugh interests, is based upon the ground that in a case on appeal no new matter can be considered, so that the refusal does not affect the strength of allegations. In conclusion it may then be said that while the opinion may dispose of the issue of illegal delay as based upon the facts presented, it leaves unprejudiced the additional charges made in the amendment. As to the validity of the 1891 patent, this issue is in better condition than before Judge Carpenter's opinion, for it has the weight of his adjudication in its favor, and is unaffected by the decision on appeal, not excepting, we believe it may be said, the suggestion of the latter court. The opinion, therefore, as predicted in these columns, materially modifies the adverse conclusions that might have been drawn from the bare decision, and the course now indicated is a contest by an alleged infringer of the validity of the 1891 patent on all of the points entering. Such a suit would seem to have a more favorable prospect than the Government suit at any time presented, for it would involve none of the complications that have entered into the latter.

The Buffalo-Niagara Franchise.

At the meeting of the Buffalo Council on June 6, the astonishing announcement was made that the Niagara Falls Power Company had not yet been officially notified of the action some weeks ago of the Council with respect to granting a franchise to that company for the introduction of current from Niagara into the city. At the same meeting of the Council, Jacob Busch and Thomas Murphy, on the part of another company, asked permission to lay conduits, string wires and erect poles throughout the city.

The petition stated that the Niagara Falls Power Company had been negotiating with the city for about a year without accomplishing anything. It was also stated that the applicant company would arrange to connect with any power company, and that it desired the privilege of using any and all of the streets of the city subject to reasonable restrictions. The application was tabled by the committee for two weeks, and the corporation counsel requested to prepare a franchise and to advise the aldermen of the power vested in the city to grant a franchise.

Niagara Meeting of the American Institute of Electrical Engineers.

Since the preliminary programmes of the Niagara Falls meeting were distributed to the members, the convention rate of one and one-third fare on the certificate plan, has been granted by the Central Traffic Association and the Boston Passenger Committee. This together with the concession of the Trunk Line Association covers practically all the territory east of the Mississippi River and north of Richmond and St. Louis, conditional upon an attendance of 100 who have traveled by rail to the meeting. Those who expect to attend the meeting, whether members or not, are requested to send their names to the secretary at 26 Cortlandt Street, New York.

Production of Copper and Zinc.

Comparing the production of copper and zinc for the years 1893-94, the *Engineering and Mining Journal* says that while our total production of copper showed an increase of 26,250,000 pounds, the estimated value at the place of production was lower by $1,640,000 in 1894 than in 1893. The output of copper during the last year was 110,483 metric tons, and of zinc, 74,004 metric tons. Similarly, the production of zinc decreased only 2,250 tons or about 3 per cent., while the value reported was less by about $1,000,000 or 16.6 per cent.

The Berliner Opinion.

The opinion of the United States Court of Appeals in the Berliner case, which was made public on Friday of last week, is of unusual length, covering 40 large octavo pages as printed. The opinion was written by Justice Putnam and concurred in by Justices Colt and Nelson. The greater portion is devoted to considering the issue of illegal delay, and of this we shall abstract merely the more general clauses, as the arguments refer principally to technical points in Patent Office procedure, and to the course of the Drawbaugh patent litigation.

The opinion first takes up the point of illegal delay in issue, and proceeds to dismiss from consideration the point, that since the Berliner patent extends "against justice and equity" the original monopoly of the Bell Telephone Company, the latter company should therefore have exercised extraordinary diligence in speeding the Berliner application. So far as the law is concerned, it is held, the patent in suit is to be tested independently of the Bell patent. There can be but one law touching alleged delays in the progress of an application through the Patent Office, and touching the duty of applicants with reference thereto, whether the invention was from the outset seen to be valuable, or only afterward proves to be so, or always remains of little account. To deny this is to deny that the laws are equal, and would furnish a standard for the determination of the rights of patentees too fickle and imaginative to form a proper basis for the use of a court of law.

Exception is taken to Judge Carpenter's statement that the Bell Company "intentionally delayed" the prosecution of the Berliner application, the evidence only admitting of a claim that it submitted to delays which it was in its power to prevent. In order, however, to undertake to lay down a rule of law or of fact that acquiescence in the delay of a public official who is bound to perform a certain act involves an unlawful purpose because it may result to the advantage of the applicant, an important element should not be omitted. If the applicant is under no obligation touching the delay, there is no rule of law by which it can be said that, because he may receive an incidental benefit therefrom, his purpose in relation thereto is unlawful. A man's motives will not make wrongful an act which, in itself, is not wrongful.

Referring to the epithets charging the commissioner, and other officers of the Patent Office, with conscious violation or neglect of duty, or ignorance and incapacity, the opinion states that they are unsupported by the proofs in the case, unless it can be claimed that they constitute the language which the law applies in consequence of delays which possibly might have been prevented by the public officials.

The court feels compelled to say that if the record suggests any dereliction of official duty, it was in the form of a continued hostility to the American Bell Telephone Company, and of an indisposition to grant the application for the Berliner microphone, with a concurrent disposition to nurse and favor the Drawbaugh application, either for its own direct advantage, or for the purpose of defeating inventions controlled by the defendant corporation. Notwithstanding the proofs do not convict the officials, they show enough to have warranted the American Bell Telephone Company in guarding itself against the possibility of such a disposition on their part during the period covered by the nine years between June 9, 1882, and the issuing of the patent now in dispute. Under these circumstances, and after the American Bell Telephone Company and its solicitors had performed the customary duties with reference to the forwarding of its application, including all those things required by statute, or by the Patent Office, the prompt performance of all which is conceded by the United States, it is not for a court of law to say that that corporation, as to all the unofficial methods which it might take, or might omit to take, for the advantage of its case, was not entitled to use its own judgment with reference to the methods and persistency of representation to public officers, especially those whom they had some reason to regard as unfriendly.

As to the extreme diligence incumbent on the part of the Bell Company, the court holds that the United States has not established that such a duty was necessary. As far as the proofs go, the course of the application was in accordance with the usages of the Patent Office, and was such as the officials there, acting in good faith and according to their practical experience, determined at the time to be on the whole the best. To say that the Bell Company was, as claimed, bound to do in the public interest all that it had a right to do in its own, and that if it did not do this it should pay the penalty of a forfeiture of an invention said to be extremely valuable, is, the opinion states, a proposition so unreasonable that the mere statement of it by the United States seems to confess the weakness of its case. It declares that the whole tenor of the case of the United States, so far as it is supported by the proofs, has this same aspect, through the appearance of requiring of the defendant corporation a degree of diligence and astuteness apparently greater than that which would be expected from other inventors.

After examining the evidence the court states that it is plain the commissioners were at various crucial points personally acquainted with the magnitude of the controversy, and with some of its details. Knowing its magnitude, they knew, at least in a general way, that detriment to the public interests would come from delay in the progress of the case, in the event that it was followed by the issue of a patent. This was all which it was necessary they should know, as it is the pith of the entire complaint of the United States. Having this knowledge, the claim of the United States that the American Bell Telephone Company should have suggested on the record, or anywhere else, that delay in the application was prolonging the monopoly of the microphone, falls, of course, to the ground, unless the extreme proposition is accepted that it was the duty of that corporation to keep this fact constantly before the eyes of the commissioner personally.

Discussing the claim that the Patent Office could have disposed of the Drawbaugh application, and thereby released the Berliner, the court says that the American Bell Telephone Company was compelled, with reference to the progress of this application, to meet the practical condition of things, and, therefore, whatever may now be said as to the theoretical side of the law, it is more appropriate to the purposes of this case to observe that Drawbaugh's solicitors did succeed in practically retaining his application under adjudication by the Patent Office, until near the close of October, 1891. The American Bell Company is not subject to just criticism if it accepted the situation as it found it.

In regard to awaiting the result of litigation in the Drawbaugh case, the court says it is satisfied from the evidence, and the reason and probabilities of the thing, that whatever common consent there was to abide the result of the litigation, was the consequence of the independent judgment, formed fairly and honestly—at least by the officials of the Patent Office and by the representatives of the American Bell Telephone Company—that on the whole this was the best thing to do; and the common consent consisted only in the interchange of these views. But assuming, the opinion continues, that it was not wise, that, under the circumstances, the commissioner made an error of judgment, that it was his duty to have proceeded regardless of the pending litigation, and that also the American Bell Telephone Company committed an error in sharing his judgment, is the court to impose on this corporation the penalty of losing its valuable patent on that account, and give the United States, whose officers also shared in the same error, the entire benefit of the penalty? On every principle such a conclusion would be an outrage on justice, and in violation of the fundamental rules by which the law refrains from imposing punishments on parties who honestly exercise their judgments under the existing circumstances, especially circumstances of difficulty. The court concluded that in this connection the American Bell Company had done all that reasonable usage required of it.

The practical summing up of the various suggestions of the Government, according to the Court, amounts virtually to a censure of the American Bell Company for not reforming both the practice and officials of the Patent Office, and it thinks that the case may be justly stated in this form; this demand is declared without parallel or precedent, and thus put, the case shows itself so revolutionary as to require the legal mind to request it on mere statement.

The opinion on the issue of illegal delay concludes by stating that the United States has not established that there rested with the Bell Company an extraordinary duty which could be discharged only by the greatest possible diligence in the prosecution of its application. Moreover, if there was any such rule in law, the United States has failed to meet the burden resting on them, of proving that the lack of compliance with it in this case had any practical result in producing the delays complained of. It would, indeed, be quite plausible to declare that the American Bell Telephone Company, with all its resources, could have found some way to break the deadlock if it had earnestly desired so to do. But the courts have never yet been vested with authority to deprive any person or corporation of property or rights on the strength of any such mere assertion, nor without allegations and proofs in a definite and prac-

tical form. The lack of these aids the proposition that there is no such obligation as claimed by the United States. There is no precedent, nor does the proposition of the United States rest on any principle which can be supported by authority from any quarter, or by any method of reasoning which connects it with any fundamental legal doctrine. By granting a patent for a meritorious invention the United States parts with nothing which it before had, but only recognizes and supports for a limited period the equitable title of the patentee. The court thinks this is the first instance where the common law prevails, that it has been sought to revoke by legal proceedings, on the ground of imputed or merely legal fraud, a grant of this character, issued to a subject after full official knowledge of all the facts, where there has been no deceit, collusion or corruption, and where the subject duly complied with all statutory and departmental requirements, merely because the officers in charge have been dilatory and the subject failed to use zeal in spurring them on. The law goes quite far enough in protecting the State against the acts and omissions of its agents, without the court pushing to the extreme of adopting this heretofore unheard of proposition.

The court adds that while the delay in this case was unusual, it was not unprecedented, as shown by the record, and results from something in the Patent Office system which should be corrected by Congress and cannot be reached by the courts.

The other issue in the suit is then taken up—that the 1891 Berliner patent is void on the ground that the 1880 Berliner patent was granted upon the same application to the same applicant for the same invention. Referring to the fact that the United States rests its case on this point on the Miller vs. Eagle Manufacturing Company decision, the court remarks that the facts in the case at bar on their face are not like those of the Miller vs. Eagle, as here the two patents claimed to interfere were not issued to the same applicant, and the acquirement, after it issued, by the American Bell of the 1880 patent would not necessarily estop the assignee. As this point is not made by the Bell Company, the court considers that the case raises an estoppel, of which the parties were aware, not brought to the attention of the court, and, therefore, it is compelled to investigate the question independently of that suggestion.

The opinion proceeds to say that the most that can be claimed by the United States is that the officials of the Patent Office, having all the law and facts before them, erred in the exercise of their free judgment in the determination that the earlier patent did cover the invention described and claimed in the later one. Even were this so, the result was not a mistake in the sense of the law in its application to the principles of cancellation of deeds and other instruments; but it was merely an erroneous judgment and determination of the ultimate fact deduced from the primary facts, all of which were known.

As the court is clear that this proposition of the United States cannot be sustained on the law, even admitting the facts to be as claimed, it adds that it will not undertake to determine the question of the substantial identity of the respective claims of the two patents, or any of them, preferring to leave that without prejudice in the event it hereafter involves other individual or corporate rights.

The court considers the main question to be, whether the issuing of the second patent to the same applicants for the same invention, under such circumstances that it was not clearly manifest that the inventions were the same, and that there might be a reasonable difference of opinion on the point of identity, involved in the view of the statutes touching patents such an excess of power as would justify a court in equity in rescinding the second patent thus issued. The court states it cannot put the case more strongly than this in favor of the United States, because at the best it must be admitted by the United States that there is a reasonable doubt on the point of identity. A number of decisions are cited and discussed, and the court concludes that it is evident that the action of the commissioners, so far as this issue is concerned, was merely a finding of facts, and that a statute quoted vests in the commissioner of patents authority to issue such patents as on examination he deems proper to issue, that none such issued are *ultra vires*, that all such are within the scope of his powers within the meaning of expressions cited from the Supreme Court, and that there is nothing in this case which excepts it from the general rule, that, under these circumstances, the courts can exercise no jurisdiction.

"But," concludes the opinion on this point, "we have pursued the matter already further than was necessary. It is clear, on this part of the case, that we are barred from taking jurisdiction by reason of the statute provisions which give special remedies to an applicant whose patent is refused, and, passing by this, that also the issue of this patent was within the scope of the authority of the Commissioner, and no mistake being proven, and no other equitable ground appearing, we cannot revise his action in this suit."

The court refuses permission to file an amendment to the bill, alleging that the Bell Company and representatives of the Drawbaugh application acting in concert procured the consent of the commissioner of patents to await the decision in the Drawbaugh cases, the Bell Company thereby violating its duty to speed the patent for the microphone. The court states that it had already found that, as the record now stands, it contains no proof to sustain an allegation of this character. Therefore, an amendment of this nature would require the opening of the record below for further proofs. It is not at all a case where a complainant has proved his case, but his allegations are found by the Appellate Court to be inapt. To grant this motion would, under the circumstances, violate all the rules requiring diligence from parties complainant.

The decision reverses the decree of the Circuit Court and remands the case to that court with directions to dismiss the bill.

Twaddle.

The following, clipped from a non-technical exchange, is a characteristic specimen of the literature which the public accepts as scientific on account of the jumble of scientific terms employed.

"The time is fast coming when it will be easy to understand the physics of the breath of life, or of the oxygen of respiration, which is also the oxygen of combustion; how the inrush of oxygen by way of the capillary gates of the lungs, and the corpuscles of the blood, to the tissue cells of all parts of the system, carries a ceaseless volume of vital energy; how this animating and life-maintaining energy is nothing less than electricity of absolute dynamic strength and sureness—every breath, according to its size, a definite quantity of vitalizing, heating and sustaining energy; and how the flow and charge of this energy, in all parts of the system, will maintain functions and operate organs, which it has in fact created. The knowledge from which we speak is not yet recognized, because it is new, and belongs to a new system of nature so comprehensive as to require for its demonstration a survey for which the present teachers of science are not prepared, not even the most eminent of them. It requires long and elaborate research to bring into one view the facts of chemistry, of physics, of electricity and magnetism, of zoölogy, anatomy, physiology and botany, and of medicine and surgery, which fall into the demonstration that life is not, as the system now in vogue has it, 'a mysterious potency, always associated with a peculiar form of matter called protoplasm'; and which 'so far as we know, has always resided, as it does to-day, in little masses of protoplasm, called cells' (Dr. T. Mitchell Prudden); but is the definite direct effect of a stream of electrical energy blown into the protoplasm by the oxygen of respiration; but in view of the whole history of science, from Aristotle and Hippocrates to Darwin and Koch—in view of the long roll of demonstrated facts, and of the theories that have held on in the struggle of systems for existence; we may declare with the utmost confidence that the electrical function of the oxygen of respiration in all living things, animal and plant, and the electrical character of vitality in both animals and plants, is by far the surest and best demonstrated, as it is also by far the greatest and most comprehensive discovery the human mind has ever made—even if we take no note of the demonstration, which the system embraces, that all matter is electrically animated, however motionless it seems; that all atoms receive their character from the electrical charge which they carry; that all active properties and functions are electrically established, and that whatever motion exists anywhere in the material universe, from invisible particle to planet wheeling on its vast orbit in space, is due to electrical agency."

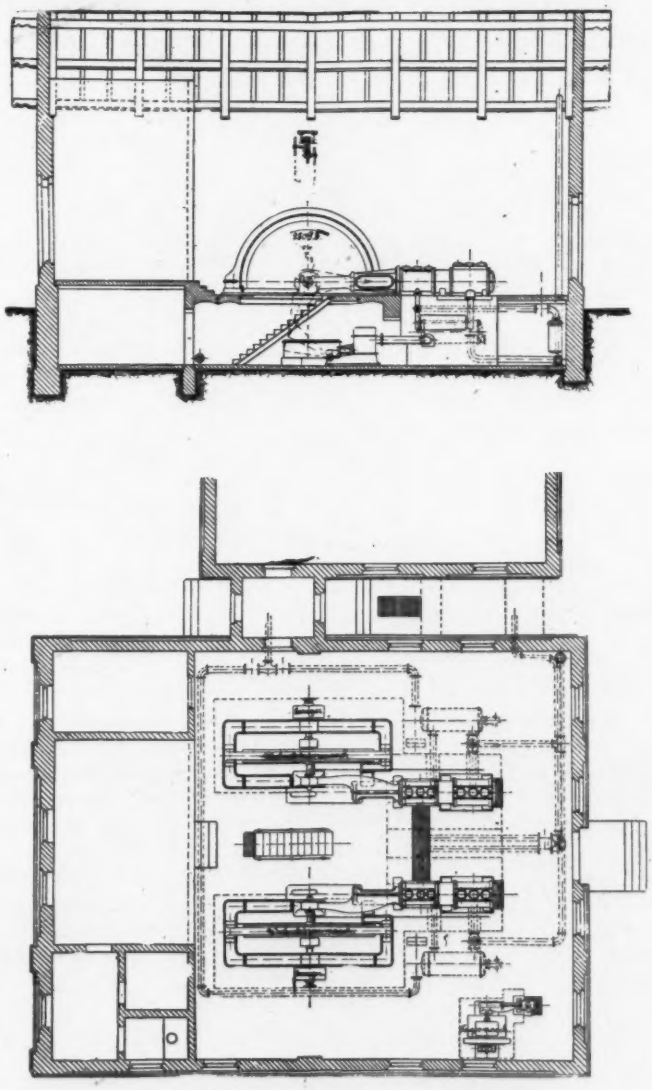
A Western Pennock.

We have received a letter from a subscriber who asks for some information in regard to an "electrician" of St. Louis who has recently interested financially a friend in a new electrical "invention." The St. Louis Pennock claims "to do away with all friction in obtaining electricity, developing all of his power from a mixture of chemicals," and that a box one foot in cubical dimensions will contain enough of his mixture to give 16 hp for 400 hours at a cost of 25 cents for the whole period; moreover, a box of his mixture will run "a storage battery street car" for one month at a cost of $2, developing 16 hp during that time.

The Electric Lighting of the Baltic Canal.

BY CARL COERPER.

A PROBLEM such as the lighting of the 61.3 miles of the Baltic Canal was one that was new to electrical engineering. It is true that the electric current had been carried over a greater distance, to be there used for power and lighting; but this is a comparatively simple problem, which was first solved with practical results by Ganz & Co., of Budapest, in their transmission of the water power of the Arno at Tivoli, 17 miles to Rome, and which cannot be compared in difficulty with the lighting of the whole length of the Baltic Canal. It is easy to conduct the electric current to one point and there regulate it, while there are considerable difficulties in operating at great distances a large number of lamps in line with each other so that the safety and economy of the operation and of the plant is assured. The Helios Company, of Cologne-Ehrenfeld, which during the last ten years has developed and brought into use the alternating-current transformer system in Germany, was in a position to solve the given problem in a complete manner.



PLAN AND ELEVATION OF STATION.

As it was necessary not only to light the line of the canal itself, but also to provide for the great demand for illumination of the locks, harbors, buildings and lighthouses, the following fundamental conditions were laid down:

1. Two operating plants to be built, one at Holtenau, the other at Brunsbüttel.

2. The plants to have the most reliable and economical machinery and apparatus, and a complete reserve is provided.

3. The potential automatically to be kept constant in the two operating plants, however much the load may vary.

4. Each light to be completely independent of the others, so that the extinguishing of a great number of lamps will have no influence on those left burning.

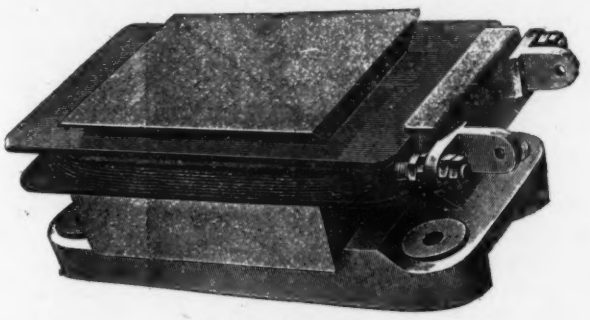
5. All minor accessory apparatus, such as main current regulators, oil insulators, etc., to be avoided.

This programme was carried out in the following manner:

At the two locks at Holtenau and Brunsbüttel central engine plants were erected, containing the hydraulic pressure apparatus for operating the gates of the lock and the windlasses; connected with this was a large boiler plant, which was to be used for operating the electrical machines also.

In accordance with this plan, the buildings for the electrical machines were erected beside the central engine plant, as shown in the accompanying plan.

Each plant contains two Helios low-speed, direct-connected generators. The machines run at only 85 revolutions a minute, and have a capacity of 200 effective horse-power apiece. The steam engines are horizontal tandem with valve governing, and were built by the Augsburg Engine Works. The cylinders are 15.75 and 24.41 inches in diameter, with 39.37 inches stroke. At Holtenau surface condensation is contemplated, but the engines can also be connected with the central condensing apparatus of the hydraulic plant, or can exhaust into the air. Between the two bearings of



AN ARMATURE COIL.

each steam engine one alternating current machine is mounted on the shaft, the magnetic field forming the fly wheel, while the armature rests on the beams connecting the two bearings. The rim of the fly wheel is hollowed out, and in the recess all around are fastened the 72 magnets, made of laminated plates .02 of an inch thick. Care is taken to have the magnetic circuit complete. The exciting winding is held in place by heavy shoes. The diameter of the magnet wheel is 15 feet 6 inches; the speed at which the lines of force are cut is, accordingly, 65.94 feet per second, with 6,120 alternations per minute.

The armature is not only divided in the plane of the shaft, so that the upper part can be lifted off, but the whole rim can be moved aside, by means of a track on which it slides, far enough for the magnetic field and the armature coils to be entirely free. Besides this, the armature coils are so arranged that they, together with their cores, can be taken out sideways by loosening four screws.

The accompanying illustration shows an armature coil with an armature core; it is to be remarked that the former ⊥ form is here abandoned; the iron is considerably broadened over the coil on the side toward the magnetic field, so that the cores placed next to each other present a surface, interrupted only by small interstices, to the magnetic influence. The first of these designs was delivered to Amsterdam by the Helios Company in 1889. It has been found that with proper calculations of this arrangement a very considerable improvement of the machine is attained, without having combined therewith the great deficiency of the so-called "hollow armatures."

The potential of the alternating current at the binding posts amounts to 2,000 volts. The current curves and the design of the magnetic and electric parts are so chosen that on the one hand an economical operation of the arc lights with eight volts at the binding posts of the lamps is assured, and on the other, the phase shifting following from the distant transmission, exerts as little influence as possible.

The exciter is a four-pole shunt-field machine, with laminated armature, mounted on the free end of the shaft beyond the outer bear-

ing. The potential of the exciter is from 120 to 150 volts. The field of the exciter is automatically regulated by a Tesla motor without commutator or collecting rings. This motor cuts resistance into the field of the exciter when the potential rises above the 72 volts to which it is transformed in the generator house, and cuts resistance out when the potential drops too low. As this regulation is effected with, at the most, one ampere on the very heavy contacts, it meets the highest requirements of safe and certain operation.

The generators, at normal load, with a steam pressure of 90 pounds at the valves, deliver 100 kw of useful energy to the conductors, with a steam consumption of 2,750 pounds; that is to say, 1 kw with 27.5 pounds of steam per hour.

One generator at Holtenau, as well as one in Brunsbüttel, suffices for full operation, so that the second set of machines forms a complete reserve.

At Brunsbüttel a small steam dynamo of 9 to 12 hp, has been erected for lighting the lock chambers during the daytime. This machine runs at 150 revolutions, and can also be used as a reserve for the excitation of the alternators. The steam engine has a cylinder of 5.91 inches diameter, and 13.78 inches stroke, and is governed by sliding valves

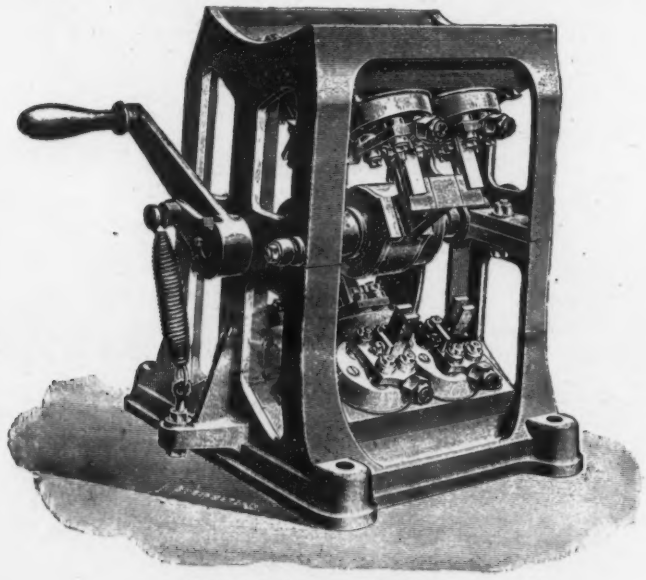
It also was furnished by the Augsburg Engine Works. On its shaft is mounted the laminated armature of a continuous-current shunt-wound machine, with a four-pole field magnet.

As the lock gates at Brunsbüttel have to be moved during the greater part of the day, it became necessary to have this smaller dynamo, as it was not economical to run the large alternators for the small amount of lighting in the machinery chambers in the walls of the lock. At Holtenau, the lock gates are moved only about 25 days in the year, and for this reason a small "day dynamo" was not installed here.

The switching apparatus differs considerably from the switchboard erected by the Helios Company in the large central stations at Cologne and Amsterdam and the one in course of construction at Dresden. Outwardly, considerable attention has been paid to a proper appearance; the Renaissance frame is of gold-colored bronze, beaten work throughout. The operating apparatus is moved by powerful levers, and every connection has a two-pole cut-out switch, as shown in the accompanying cut.

The insulation is triple in every case, consisting of porcelain and a double insulation of hard rubber. All the apparatus is tested with 10,000 volts.

The measuring instruments are all mounted on white marble with



Double-Throw Switch.

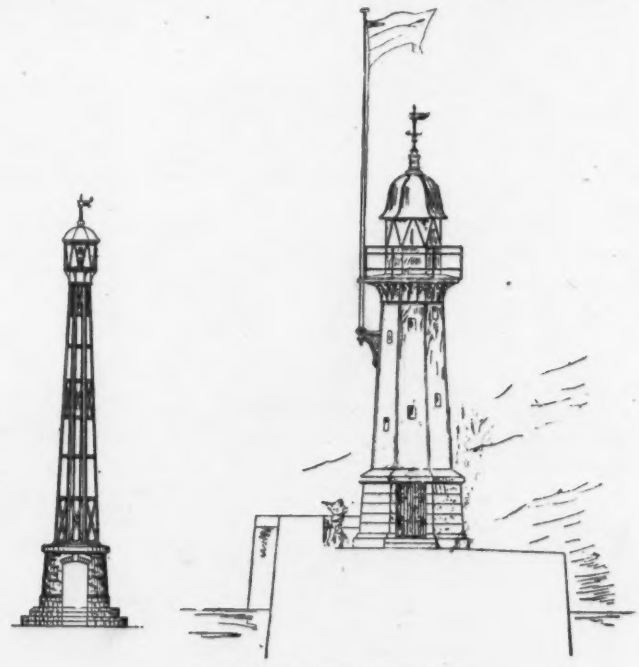
hard rubber; these allow not only the potential and current strength of the excitation to be read off at any time, but also the potential and current strength of the alternating current, as well as the useful watts delivered. For parallel coupling there are artificial resistances of asbestos thread wound with nickel alloy wire, which are cut in and out by a key arrangement. The phases are shown not only by two lamps connected with a transformer, whose double high-tension winding is fed by both machines, but also by a phase indicator. This consists of a movable plate in front of two magnet poles energized by the two machines, respectively. In case the phases of both machines agree, the plate stands still, otherwise it moves with the machine whose phase is in advance, in one or the other direction.

For lighting the boiler and engine houses, the buildings, the walls of the locks, the machinery chambers, and the harbors, the high-tension current of 2,000 volts is transformed down to the required working potential by means of standard Helios trans-

Transformer.

formers, such as shown in the accompanying cut. A large number of arc lamps and incandescents have been installed for lighting in and about the plants at Holtenau and Brunsbüttel. The standards on the walls of the locks each hold four lamps of 25 cp apiece. The conductors are almost without exception concentric iron ribbon-armored cables, laid underground. At Brunsbüttel the lighting is as comprehensive as at Holtenau, and concentric cables are also used.

The entrances to the harbors are marked by electric lighthouses. The two harbor lights at Brunsbüttel are at the extreme points of the moles, which extend far into the mouth of the Elbe. At



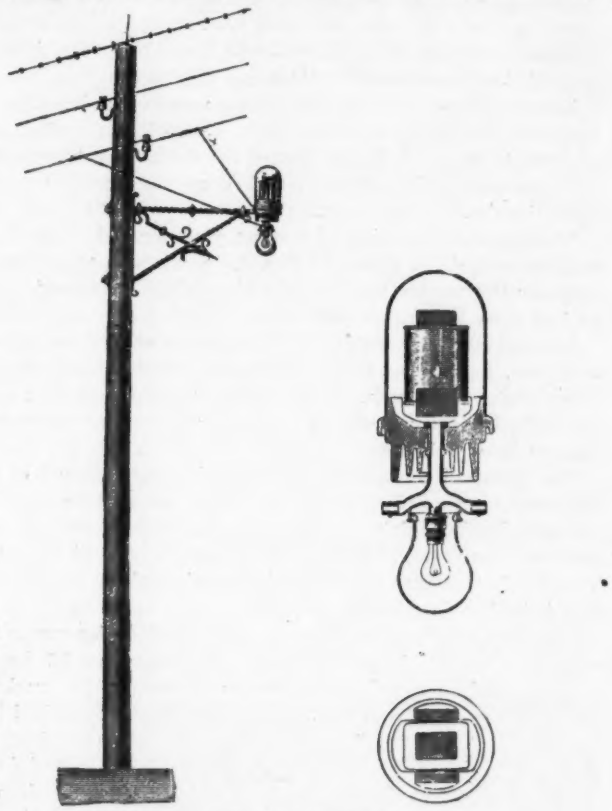
Electric Lighthouses.

Holtenau, the northern light is placed in the lantern of the "Kaiserhalle," while the southern lighthouse is built of iron frame work on a massive foundation.

The line of the canal 61.3 miles long, is divided into four sections in such a manner that one section extends from Holtenau for 29 miles on the north side of the canal and one for the same distance on the south side, and from that point there are two other sections, one on each side of the canal, reaching to Brunsbüttel. In this way there are four rows of lamps, for each of which going and returning conductors had to be provided. From Brunsbüttel the

length of this circuit on the north side of the canal amounted to 61 6 miles and on the south side to 62 miles; from Holtenau the north side line was 61.2 miles and the south side 60.2 miles. Each of these sections supplies 250 incandescent lamps of 25 cp each, so that the apparent average distance from lamp to lamp is 643 feet. As, however, the lakes which are traversed by the canal have no electric lighting (the channels in the lakes being marked by gas buoys during the night), the actual average distance between the incandescent lamp is about 524 feet. In reality the distance varies from 250 to 800 feet, as in the straight stretches of the canal the illumination with an 800 feet interval is entirely sufficient, while at the curves the distance apart of the lamps is correspondingly less. For after all, the principal thing is to show vessels their course clearly by night. The conductors along the canal consist of No. 6 B. & S. copper wire insulated with triple "Doppelglocken" first introduced

MAP SHOWING ROUTE OF CANAL.



DETAILS OF POLE AND LAMP.

by the Helios Company, and is carried on stout wooden poles at intervals of 130 feet. At the points where lamps are placed the line is in nowise broken, but makes a number of turns about an iron core, so that there is an entirely uninterrupted circuit. The incandescent lamp conductors are attached to the ends of these windings and are in parallel to them. The iron core and the incandescent lamp are so designed with respect to their magnetic and electric properties, that when the lamp is burning, only 9 per cent. of the current consumed at the lighting points goes to the iron core and its windings. If, however, the lamp be defective, the whole current passes through the windings about the iron core, so that, as remarked above, no interruption can occur in the circuit. The calculations have been so exact that over one third of the 250 lamps in each section can be destroyed or out of action without making necessary any regulation of the whole system at the opening plant. The potential at the lamp terminals is 25 volts; besides this, the great resistance of the conductors has to be overcome, so that a potential of about 7,500 volts is continually maintained at the binding posts of the canal conductors in the operating plant. This potential is reached by transforming up the dynamo current of 2,000 volts. The accompanying illustrations give a view of the pole with the lamp which is mounted on a wrought iron bracket together with the iron core and its windings, and also show an enlarged section through the insulator, iron core and lamp. All the poles as well as the line are protected against lightning by means of a barbed fence wire. The line on the north side is carried under the canal itself as well as under the streams emptying into the canal by means of armored cables. The cables are buried three feet deep in the bed of the canal, and consist of two non-inductively arranged rubber tubes covered with gutta percha. The armor is made of galvanized iron wire. The cables have been tested with 15,000 volts, so that they appear to be safe for the operating potential of 7,500 volts. These, as well as all other cables used in the plant, have been furnished by the Rhenish Rubber Goods Works of Franz Clouth in Cologne-Nippes.

From what precedes it will be seen that the programme announced at the beginning has been completely carried out. The plant operates with entire certainty, is self regulating and very economical, and at the same time every lamp is entirely independent of the others.

For lighting the festival buildings and places in Holtenau during the opening celebration, the operating plant there will furnish current for 165 arc lamps and over 500 incandescents, besides taking care of the illumination of the canal and lock.

For erecting work on the line of the canal, the 12-hp electric launch *Helios*, shown in the initial cut, was used, which at a speed of 9.3 miles an hour can traverse the whole canal in about seven and a half hours.

Alternators.

At a recent meeting of the Royal Society, Dr. J. Hopkinson and Mr. E. Wilson read a paper on this subject. The paper deals experimentally with the currents induced in the coils and in the cores of the magnets of alternating-current machines by the varying currents in and the varying positions of the armature. It is shown that such currents exist, and that they have the effect of diminishing to a certain extent the electromotive force of the machine when working on resistances as a generator without a corresponding effect upon the phase of the armature current. It is also shown that preventing variations in the coils of the electromagnet does not, in the machine experimented upon, greatly affect the result, and that the effect of introducing copper plates between the magnets and the armature has not a very great effect upon the electromotive force of the armature, the conclusion being that the conductivity of the iron cores is sufficient to produce the main part of the effect. A method of determining the efficiency of alternating-current machines is illustrated, and the results of the experiments for this determination are utilized to show that in certain cases of relation of phase of current to phase of electromotive force, the effect of the local currents in the iron cores is to increase, instead of to diminish, the electromotive force of the machine. The large majority of the experiments described were made in the summer of 1893, and a considerable part of the paper was then written. The authors were assisted by Mr. F. Lydall, one of the student demonstrators at King's College at that time.—London *Electrician*.

Electrical Engineers.

An article under the above caption in our issue of May 11, and clipped from an exchange, was erroneously credited to the London *Electrician*.

The Westinghouse Electromagnetic Railway System.

The Westinghouse Electric & Manufacturing Company announced last week that it had purchased the stock of the Electromagnetic Traction Company of West Virginia, which controls the Wheless system. This system is now in use on a road in Washington, D. C., and is similar to one patented by Mr. Westinghouse, and with which he has conducted lengthy experiments at Pittsburg. It is stated that the Wheless patents are broader than those of the latter, which led to their purchase. We give below a description of a working model of a car and track now on exhibition at the Westinghouse offices at New York, and which combine the ideas of both Mr. Westinghouse and Mr. Malone Wheless.

The apparatus employed in this system is simple, and the cost of construction, while greater than that of the trolley system, is claimed to be much below that of the ordinary cable conduit. Very little excavation is necessary, and does not involve going deeper than the ties.

The apparatus consists of contact pins located between the rails, and connected, as shown in Fig. 2, by wires to switch boxes placed between the tracks, the feeder cables being connected to the latter, and of three sliding contact bars attached to the car trucks.

The contact pins are arranged in groups of three each, and are of cast iron, five inches in diameter, and extend above the pavement five eighths of an inch. They are set in granite or terra cotta blocks seven inches square, which, in turn, rest in cast-iron cups having flanges by which they are spiked to the ties.

The group of contact pins are placed about seven feet apart, and while offering no obstruction to traffic, as will be seen in Fig. 1, are sufficiently high to enable the collector bars carried by the car to slide over them, and at the same time entirely clear the pavement. The whole structure is very substantial, and is designed to withstand the heaviest traffic.

Two contact pins of each group are connected by curves to electromagnetic switch boxes of cast iron, measuring 12 by 18 by 14 inches, and arranged alongside or between the tracks. These switches are connected to the feeder cable, which is laid in suitable conduits just beneath the pavement, and are provided with electromagnets having one winding of coarse wire and one of fine wire.

The armature of the magnet is provided with two carbon contacts, each having a contact surface of about two by two inches, through which connection is made between the feeder wire and one of the

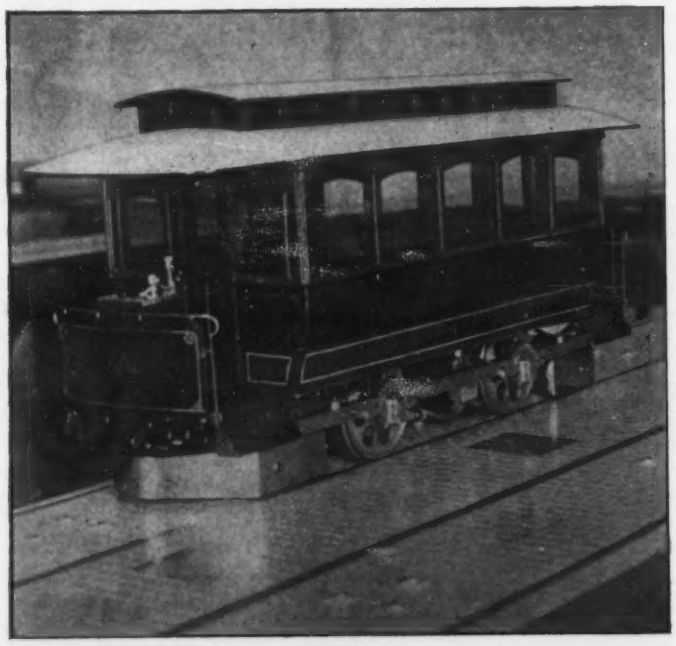


Fig. 1.

contact pins. The magnets and their connections are secured to slate supports, the whole being so constructed that by removing the cover of the box and an inner case, they may be lifted out and examined without the aid of tools, the connections with the supply cable being made and broken automatically. Each car is provided with a three-cell storage battery, and as the car moves along and the collector bars slide over the contact pins, the current from the storage battery passes through the outer contact bar to the corresponding contact pin and thence through the fine wire winding of the magnet; as the armature is pulled up by the storage battery current, connection is made by the carbon contacts with the feeder cable. The power current passes through the coarse winding of the magnet, holding the armature securely in place, and thence to the motors through the inner contact pin and the corresponding

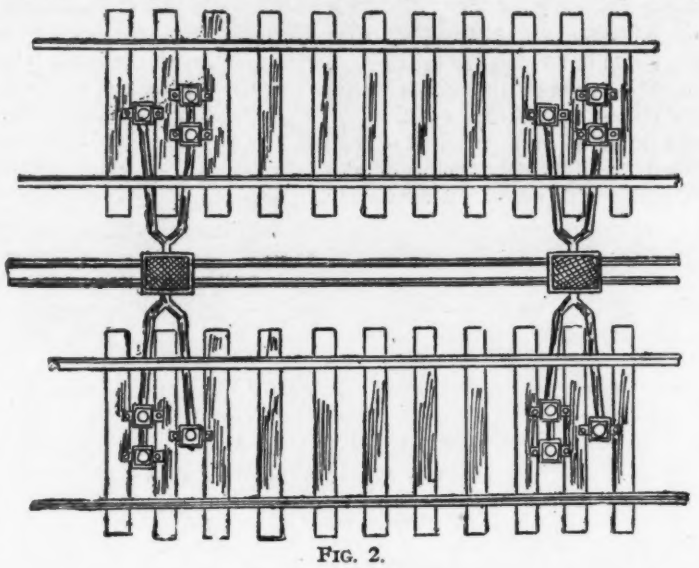


Fig. 2.

collector bar. From the motors the current passes through the centre bar and third contact pin to the return cable, which is located under the pavement near the feeder cable. So long as the tracks are not occupied by cars, the contact pins are dead, and only become alive while the car is passing over them.

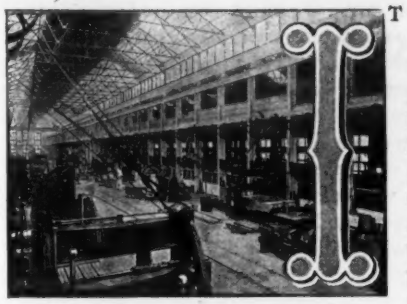
To provide against sparking in the switch boxes, the collector bars are of sufficient length to allow them to slide a distance of four feet over the forward set of contacts before leaving the rear set.

In double track work the switch boxes are located between the tracks, and are provided with two magnets, one for each track. The arrangement of its apparatus in the operation of elevated railways is slightly different from that of surface roads. In place of the contact pins, rails or metal bars, arranged 10 to 20 feet apart, will be employed.

Electric Ploughing in Germany.

Practical experiments in electric ploughing, says the London *Electrical Engineer*, have been made at Halle-on-the-Saale, Germany. Here a two furrow tilting plough was used. The electric motor is fixed to the implement itself. The shaft of the motor, by means of a double spur-wheel gear, drives a shaft fitted with a pinion, over which a chain runs from one end of the field to the other. This chain is held taut at both ends by triple ground anchors. When the motor is put in operation it will haul the plough across the field. When the end of the field is reached the plough is tilted to the other side, and by reversing the motor the plough starts on its return journey, at the same time depositing the chain sideways for the next row of furrows. The anchors are moved by a laborer, who lifts them out of the ground with a hand lever. The current is generated by a portable dynamo and 10-hp steam engine, and the current is conveyed by a cable that follows the car upon light cars, which turn readily in any direction. The power used in the heavy loamy clay at Halle-on-the-Saale was an average of eight kilowatts. The plough turned two furrows, measuring together 60 cm in width by 24 cm in depth, and, traveling at 0.9 metre per second; the actual useful effect was equal to eight effective horse-power, which showed that there was a loss of about 4 hp between the portable engine and the plough. A 16-hp engine was used for a four furrow plough, and the depth of the furrow was 24 cm. One of the remarkable features of this system is that, guided by the tightened chain, very shallow furrows can be made with great evenness and regularity, and the balance plough can thus be used for turning over stubble land and other light work. As regards attendance, only one man is needed for the lighter plough, while for the larger one three men are required—a ploughman and a man at each end to shift the anchors. The first cost of an electric plough is said to be much below that of a steam cultivating plant.

The Westinghouse Electric & Manufacturing Company's New Plant—I.



IT is almost six months since the Westinghouse Electric & Manufacturing Company began the centralization of its Pittsburg, Allegheny and Newark factories at its new plant in East Pittsburg. Owing to the vast amount of machinery and material to be transported, the transfer has been necessarily slow, but the new factory is now in complete operation, and we are finally able to place before our readers in this issue a fully illustrated description of these works. A second article will be devoted to the Tesla two-phase system which is used for the driving of all machinery throughout the buildings, and a third and final article will deal with new apparatus that has not heretofore been fully described to the public.

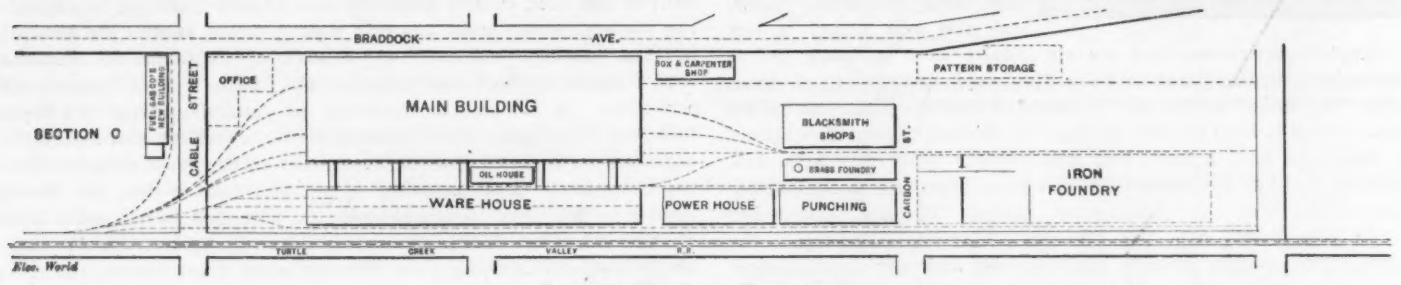
Soon after the consolidation of almost all the competing electric companies into the General Electric Company, the Westinghouse people foresaw that a new and very much larger manufacturing establishment must soon be erected in order to permit them to meet the demands of increased business. With such plans in mind they secured a plot of land adjoining the main line of the Pennsylvania Railway, twelve miles east of the city of Pittsburg. Here, as the result of a year's work and the investment of many hundred thousand dollars, there has been erected one of the largest and most complete manufacturing establishments in the world. A glance at the engravings on pages 710 and 716 will give a general idea of the buildings already erected. The accompanying ground plan shows by full lines the buildings which have already been completed and the broken lines indicate those still to be erected.

The various Westinghouse interests will soon all be centered at or near East Pittsburg—as the new station on the Pennsylvania Railway is called—for, in addition to the factory of the electric company, the Fuel, Gas & Manufacturing Company, an allied concern, is here located, and the Westinghouse Machine Company, having also outgrown its present quarters in the city, is erecting a new factory about 600 feet west of the electric company's buildings, and nearer the railway. At Wilmerding, only two miles east, are the immense works of the Westinghouse Air Brake Company, and at Swissvale, four miles nearer the city, is located the Union Switch & Signal Company, of which the electric company was originally but a department.

That Pittsburg has developed some of the largest and most successful manufacturing concerns in the world, is of course well known, and, as has been so ably stated by Mr. Andrew Carnegie in explaining the accumulation of his own wealth, these results are attained in that locality, not more by reason of its favorable situation with respect to fuel, raw material, etc., than by the exceptional perfection to which the methods of manufacturing are there brought. This same local characteristic of excellent and systematic organization is very apparent throughout all the Westinghouse Electric Company's manufacturing operations, and is due, no doubt, mainly to Mr. Geo. Westinghouse, Jr., who has been, and is still, at the head of the Westinghouse Air Brake Company, the Westinghouse Machine Company, the Westinghouse Glass Works, the Allegheny County Light Company, the East End Electric Light Company, the Philadelphia Gas Company, the Fuel, Gas & Manufacturing Company, the Union Switch & Signal Company, and finally, his latest and largest venture, the Westinghouse Electric & Manufacturing Company. As a result of his own vast manufacturing experience, and a knowledge of the methods of such companies as the Carnegie, Jones & Laughlin, etc., Mr. Westinghouse, seconded by his able corps of assistants, has developed in the electric company a form of business and workshop organization which, it is not too much to say, is equalled by few, if any, manufacturing concerns in the world.

MAIN AISLE OF MACHINE SHOP.

The situation of Pittsburg is particularly advantageous for any manufacturing concern supplying the American market, for being well inland it is convenient to both the East and West; moreover, it is in the centre of a great coal producing district; many raw materials are near at hand and consequently cheap; the labor market is of the highest grade and always abundantly supplied, and excellent transportation facilities are afforded by both railway and boat. In addition to having available these exceptional natural advantages, the Westinghouse Company has effected a wonderfully efficient manufacturing organization, and having now equipped a new and commodious factory, with all the newest, latest and most approved forms of machinery, claims, with reason, to be in a position to turn out electrical apparatus of the highest class, in almost unlimited quantities and at the least possible expense.



Ground Plan of Buildings.

Organization.—The Westinghouse Company was incorporated in 1886, and at present it has permanent representatives in most of the chief cities of the United States, and in addition a force of salesmen and engineers who are kept constantly on the road, for the purpose of meeting prospective customers and setting forth the merits of the Westinghouse apparatus. A branch company has for some years been established in London, and there does a very handsome business; in fact, it may be said that Westinghouse apparatus has not only been introduced into every State in the Union, but also into almost every country on the globe.

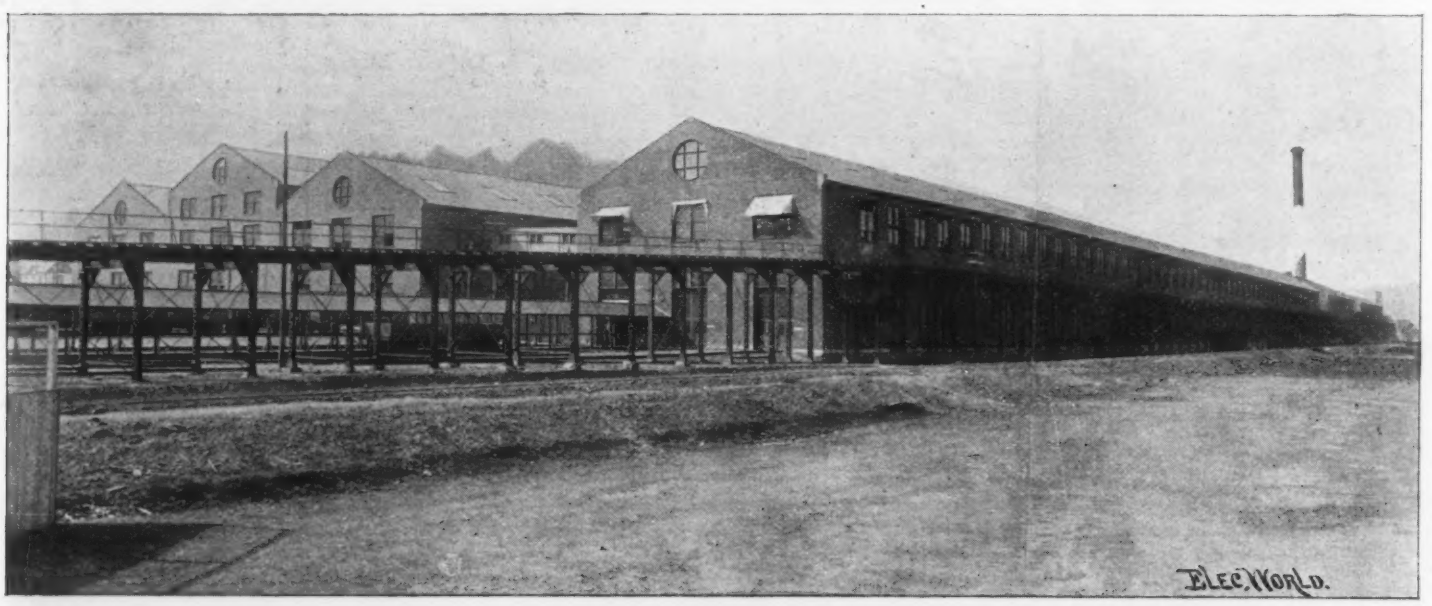
The administrative officials of the company are as follows:

Board of Directors: Charles Francis Adams, Lemuel Bannister, August Belmont, N. W. Bumstead, A. M. Byers, Marcellus Hartley, George W. Hebard, Henry B. Hyde, Brayton Ives, George Westinghouse, Jr.

Officers: Chairman, Brayton Ives; president, George Westinghouse, Jr.; first vice-president and general manager, Lemuel Bannister; second vice-president, G. W. Hebard; assistant general manager, W. C. Clark; electrical engineer and assistant manager, L. B. Stillwell; secretary and attorney, Charles A. Terry; treasurer, Ph. Ferd. Kobbe; assistant treasurer, George H. Lewars; auditor, F. H. Ketchum.

A glance at the history of electrical development will show that the manufacturing branch of the business has been controlled very largely by those who also made the discoveries and inventions. Involving, as electrical apparatus does, a grasp of higher mathematics and physics, it is not surprising that mechanical details and construction have frequently been overlooked, and consequently have often been defective. When Mr. Westinghouse undertook the manufacture of electrical apparatus, he naturally approached the subject from an exactly opposite point of view from that referred to, as his training and experience had been largely along mechanical lines, and he thoroughly appreciated the necessity for perfection in this respect; in his organization of the electric company he, therefore, gathered about him a staff of engineers, some of whom knew but little of matters electrical, but were experts on mechanical form and construction; while, on the other hand, there were a number of out-and-out electricians, who have since attained world-wide reputations. It is due to this associating together of the two classes of men that there has resulted an engineering department whose work has won for the Westinghouse Company the enviable reputation that its apparatus is as efficient mechanically as it is electrically. Simplicity, durability and efficiency has been the combination striven for, and the uniting of the various factories in East Pittsburg has unified and strengthened the staff of engineers so that these points will doubtless be more fully emphasized than ever before.

Engineering Staff.—Mr. Albert Schmid, the general superintendent, has been at the head of the electrical manufactory ever since its organization. He is a native of Zurich, Switzerland, where he received his education as an engineer, coming to this country in 1882 to enter the employ of the Westinghouse Air Brake Company. Though Mr. Schmid is still a young man, being but 37 years of age, he has had a wide experience in the manufacture of apparatus in Switzerland, Germany, Belgium, France and England, and the perfection of his mechanical conceptions are too well known to need comment. In fact he shares, equally with Mr. Westinghouse, the credit for the uniformly excellent design and construction of Westinghouse apparatus.

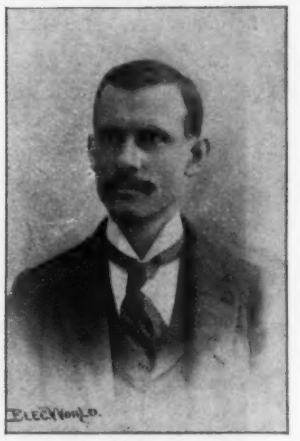


Westinghouse Factories, Looking Southeast.

Superintendent Philip Lange, who was in charge of the Newark factory before its removal to East Pittsburg, is now at the head of the manufacturing department. He is also of European birth, coming to this country in 1882, but having had in Germany con-

PHILIP LANGE.

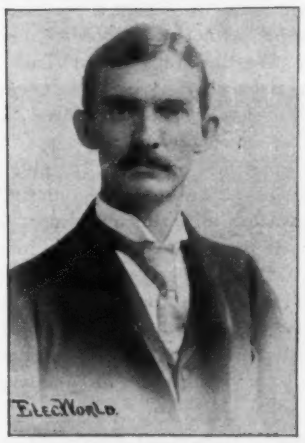
A. J. WURTS.



C. F. SCOTT.

L. B. STILLWELL.

ALBERT SCHMID.



O. B. SHALLENBERGER.

H. P. DAVIS.

B. G. LAMME.

F. S. SMITH.

The Technical Staff.

siderable experience in some of its largest electrical manufactories. Mr. Lange has been with the Westinghouse Company since 1886, and has done much in the development of its electrical detail apparatus and in systematizing its methods of manufacturing.

Mr. O. B. Shallenberger, the consulting electrician of the company, is probably best known as the inventor of the Shallenberger meter. Mr. Shallenberger is a Western Pennsylvanian, and a

View of Blacksmith Shop, Brass Foundry and Punch Shop.

graduate of our Naval Academy at Annapolis. He resigned his commission to accept a position with the Union Switch & Signal Company for the purpose of developing some electrical work which Mr. Westinghouse then had in mind. Consequently, it was but natural that on the organization of the electric company he should have been appointed its chief electrician. As Mr. Shallenberger was with the company all through its formative period, the influence of his ability and correct appreciation of requirements is apparent in all the Westinghouse alternating-current apparatus. Recently Mr. Shallenberger resigned his position to become the company's consulting electrician, with a private laboratory at Rochester, Pa.

Mr. L. B. Stillwell, who has recently been appointed electrical engineer and assistant manager, is also a young man and a native of Scranton, Pa.

Assembling Street Car Controllers.

He is a graduate of Wesleyan and Lehigh Universities and has been with the Westinghouse Company from the very first. As its engineer he has been sent to represent the company not only throughout this country, but also abroad, so that his knowledge of the practice on the two continents is both varied and extensive. Mr. Stillwell has been specializing on long-distance power transmission, and in this connection has been entrusted with almost the complete direction of the Niagara work.

Mr. Chas. F. Scott, who succeeded Mr. Shallenberger as electrician of the Westinghouse Company, graduated from the Ohio State University in 1885. After a post-graduate course at the Johns Hopkins University, and some practical experience in outside work, Mr. Scott secured a position on the "student corps" of the Westinghouse Company. His exceptional ability was quickly recognized and he has been rapidly advanced to his present important position. One of his most recent and valuable inventions is the method of two-phase three-phase transformation, which was so clearly set forth in his paper of a year ago before the National Electric Light Association at Washington.

Mr. Alexander Jay Wurts is a direct descendant of John Jay, first Chief-Justice of the United States. He graduated at Yale in 1883, at Stevens Institute in 1884, and subsequently studied two years under Prof. Kohlrausch in Germany. After two additional years of practical experience in this country, he entered the service of the Westinghouse Electric Company in Pittsburg. He has discovered some very important facts concerning the action of electricity that commonly accompanies storms, and upon the basis of his discoveries has devised improved and effective methods of protecting electrical apparatus against lightning. He is more especially known, however, for his discovery of the non-arcing metals and invention of the now well-known non-arcing lightning arrester, for which he has been awarded the John Scott medal by the city of Philadelphia upon the recommendation of the Franklin Institute.

Mr. B. G. Lamme, one of the principal designers of the company, was born at Springfield, Ohio. He took the degree of mechanical engineer from the Ohio State University in 1888, and since that time has been associated with the Westinghouse interests. During the past four years Mr. Lamme has given his attention exclusively to the calculating of the Westinghouse machines, for which important work his ability as a mathematician, and his thorough acquaintance with the best practice at home and abroad eminently qualify him.

Winding Street Railway Armatures.

Mr. Harry P. Davis, who is at the head of the detail departments, is a native of Great Falls, N. H. He graduated from the Worcester Institute of Technology in 1890, and after a year's experience with the General Electric Company at Lynn, he came to Pittsburg, where he has since been connected with the manufacturing departments of the Westinghouse Company. Mr. Davis has done valuable work in the perfecting of such apparatus as street railway car controllers, rheostats, arc lamps, etc.

Mr. F. S. Smith, superintendent of the incandescent lamp department, was a classmate of Mr. Stillwell's at both Wesleyan and Lehigh. He specialized in chemistry, in which line of work he has since made his greatest success, having discovered processes for improving carbon filaments and cements. To him belongs a large part of the credit for the development of a lamp, which so

auspiciously escaped the injunction put on the manufacture of the old Sawyer-Man lamps.

Equipment.—The main building of the Westinghouse plant is 754 feet in length, 231 feet in width, and 67 feet high to the ridge of the central roof truss. Along either side of the building, 25 feet above the floor, run galleries 80 feet in width. One of the accompanying illustrations gives a general view from one end of the shop, showing very clearly the interior arrangement, while the various other illustrations will give a better idea of the different parts of the building than can be here attempted in words.

The next largest building was designed for a warehouse and shipping room on the first floor, and a detail manufacturing department on the second floor. At present, however, half of the upper floor is occupied temporarily by the offices of the company, which are arranged as shown on the accompanying plan. Later, a separate building will be erected and all the office work transferred there. The warehouse is 574 feet in length, 76 feet wide, and 62 feet in height. The building is of the same general design as the main building, and connected to the latter, on the second floor, by means of five enclosed bridges.

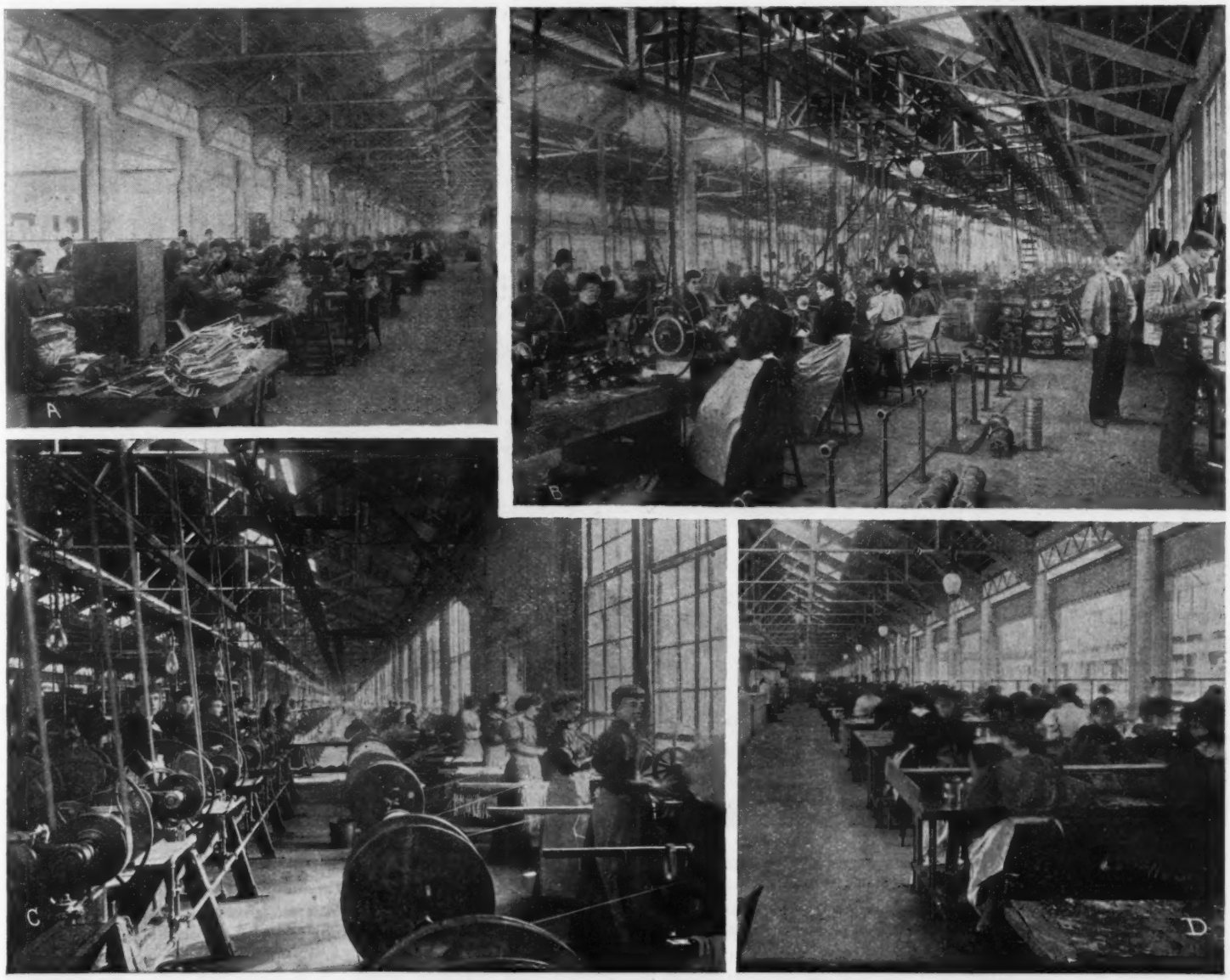
Directly back of the warehouse is the power house, a description of which is reserved for our next article, which will also give an account of the two-phase shop installation.

Behind the power house is a two-story building 258 feet long, 76 feet wide and 62 feet high, used on the ground floor for storing and annealing sheet iron. The second floor is devoted to the punching department, about sixty machines being there employed. We illustrate one of the latest types of these, an armature ring press made by the E. W. Bliss Company. A special feature of this press is that the knock-out pads are operated by a device which obviates the use of springs and consequent strain at a time when the machine is doing its maximum work. For sharpening the dies of the larger presses, a special emery grinder is used, made by the Springfield Emery Wheel Company, Springfield, Mass., a cut of which appears in another column; the emery wheel of this grinder has an oscillating motion so that each time the die being sharpened passes beneath it, there is a change in the surface presented for grinding, thus insuring an absolutely true ground surface.

Between the main building and the wareroom is a brick and iron building, completely fireproof, four stories in height, 187 feet long and 25 feet wide, used as a paint shop, drying room, and oil house. Back of the main building is the temporary carpenter and box-making shop, 192 feet by 60 feet by 32 feet. Alongside of the punch shop, and 300 feet east of the main building, is a blacksmith shop, and also a temporary brass foundry, the former 241 feet by 80 feet by 45 feet, the latter 241 feet by 40 feet by 26½ feet. The six principal and permanent buildings are of brick and iron fireproof construction throughout. The floors are slow burning, and designed to sustain 500 lbs. to the square foot. All the buildings are most pleasantly located and completely lighted by double windows 10 feet wide, situated every 16 feet along the side, and by large skylights every 32 feet in the roof.

It is, we learn, the intention of the company to still further extend its works by the erection of an iron foundry in the rear of the main buildings. At present all the castings are made in the Allegheny factory, where also the Sawyer-Man incandescent lamps are being manufactured. The glass factory, an independent concern, supplies all the glass parts of the incandescent lamps.

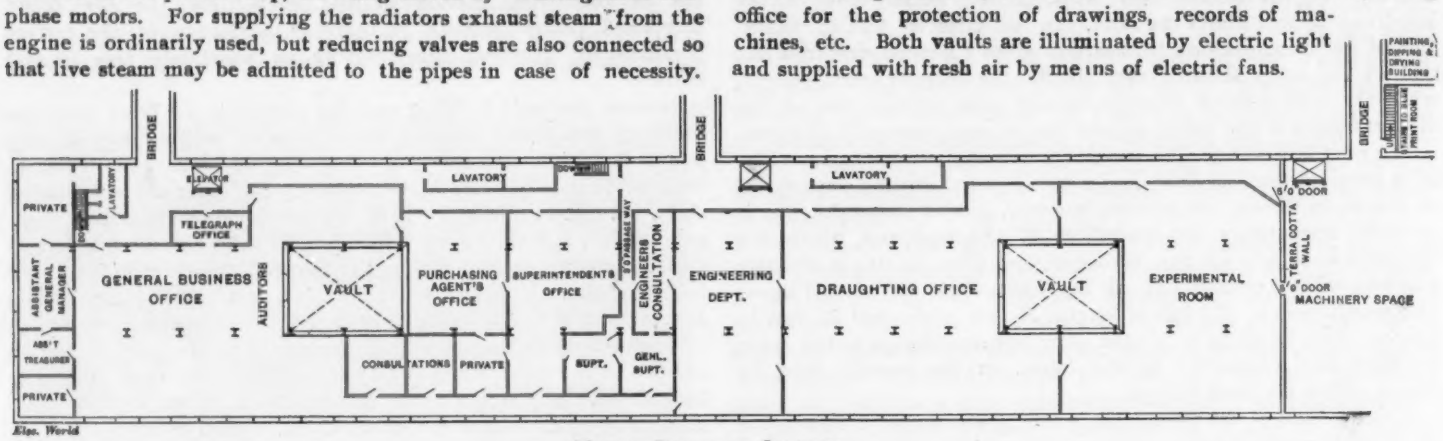
The arrangements for heating the buildings are of the most improved type. Steam radiators are located at points just under the roof, and 80-inch Sturtevant blowers are used to force the



WINDING DEPARTMENTS.

heated air through distributing pipes 36 inches in diameter at the heaters, and made gradually smaller as the air is distributed. There are two of these blowers in the warehouse, six in the machine shop, and one in the punch shop, all being driven by Westinghouse two-phase motors. For supplying the radiators exhaust steam from the engine is ordinarily used, but reducing valves are also connected so that live steam may be admitted to the pipes in case of necessity.

a pitched roof 17 feet 9 inches above the floor. They are built up of 12-inch terra cotta fireproofing, plastered inside and out, and have double fireproof iron doors. The vault in the general office is used for filing vouchers, contracts, etc., and that in the drawing office for the protection of drawings, records of machines, etc. Both vaults are illuminated by electric light and supplied with fresh air by means of electric fans.



FLOOR PLAN OF OFFICES.

The Williams vacuum system of Warren Webster & Company, Camden, N. J., is installed, and by its use the back pressure of the non-condensing engines is materially reduced.

Filtered drinking water is distributed through the various buildings by means of pipes connected to a 10,000-gallon filter, of the New York Filter Company, which is located on the first floor of the paint shop. The water supply for use throughout the factory is obtained under a high pressure from a reservoir located on the hills back of East Pittsburg. The sanitary arrangements throughout the buildings are most complete. The water supply is abundant, and the plumbing and sewerage arrangements of the latest and most approved type. The toilet rooms are finished up in slate, and the wash basins are of marbleized iron with polished brass fittings. Hot and cold water are everywhere available and the plentiful supply of soap and towels indicates the company's interest in the comfort of its employees.

For the purpose of providing convenient and quick intercommunication between the various departments and offices, there is installed a local telephone system, with instruments in each office, and a small exchange located in the west end of the warehouse. Long distance lines connect the factory with the Pittsburg Central,

GENERAL OFFICE.

and another local wire runs to the city office of the Westinghouse Company. Reference to the office plan will show two vaults, one in the auditor's office and the other opening into the drawing office. These vaults are both alike and measure 32 feet 10½ inches in length and 26 feet in width. In fact, they are small fire-proof buildings within the main building, as they have separate walls and

All machinery throughout the factory is driven by two-phase electric motors conveniently placed. Despite the fact that motors are used for power and that they are placed as near as practical to the machines they are to drive, there was necessitated, nevertheless, almost a mile of shafting in the machine shop alone.

Near the end of the main aisle of the machine shop is a new and

ENGINEERING OFFICE.

large 122-inch lathe, 30 feet between centres, made by Wm. Sellers & Company, Philadelphia; the machine is shown boring the field of a 1,000-hp alternator and turning off the armature of a 1,050-hp direct-current machine, both at the same time.

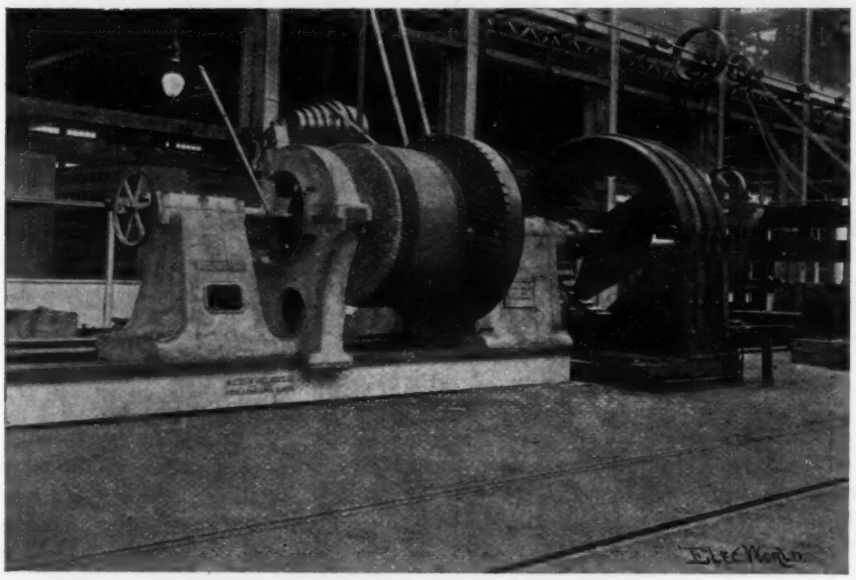
DRAUGHTING ROOM.

The Westinghouse Company has always made an object of having special tools for its work, thereby effecting economy in time and cost of manufacture and securing uniform and interchangeable parts; for the new works many additional special tools have been designed, one of which, noted in passing through the works, finishes off motor castings at one cut. For the purpose of making and repairing the tools required, there has been organized a very complete and extensive tool department, where over 130 employees are kept constantly at work making and replacing all sorts of tools, thus saving for the company the profits which otherwise accrue to tool manufacturers.

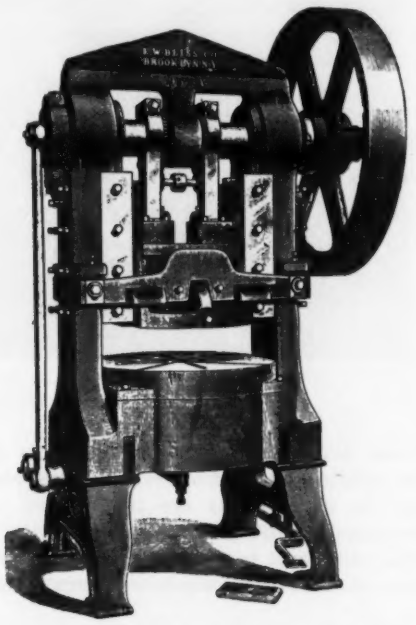
Another interesting department is the experimental room, where a number of specialists are constantly employed experimenting and carrying on original research. For their use has been fitted up a room most admirably adapted for its purpose. Here are conveniently available direct, alternating, and polyphase currents of any desired voltage, and of any number of alternations. There has also been erected a special glass-protected room for carrying on

experiments with high potential currents running up to 50,000 and 60,000 volts pressure. It might be mentioned here that the company has made some rather interesting discoveries in connection with high potential, high frequency phenomena, which have not as yet been made public.

The entire arrangements in the factory are most admirably fitted for manufacturing apparatus quickly and with the minimum amount of labor. Take for example section "A," in which the street car motors are built. In one end of the section the armature discs and shafts are received and built up. The lathe turning and filing departments are immediately adjoining, so that no time or labor is lost in transportation. Next come the armature winders, and following them the men who are employed in machining and fitting up the fields. After the motors are assembled they are turned directly over to the testing department and then passed to the packers, so that the manufacture of these machines is an almost continuous operation from the building up of the armature cores to boxing the motors for shipment. All the apparatus is manufactured in accordance with this same system, and in consequence there exists throughout the factory the most complete order and business-like regime.



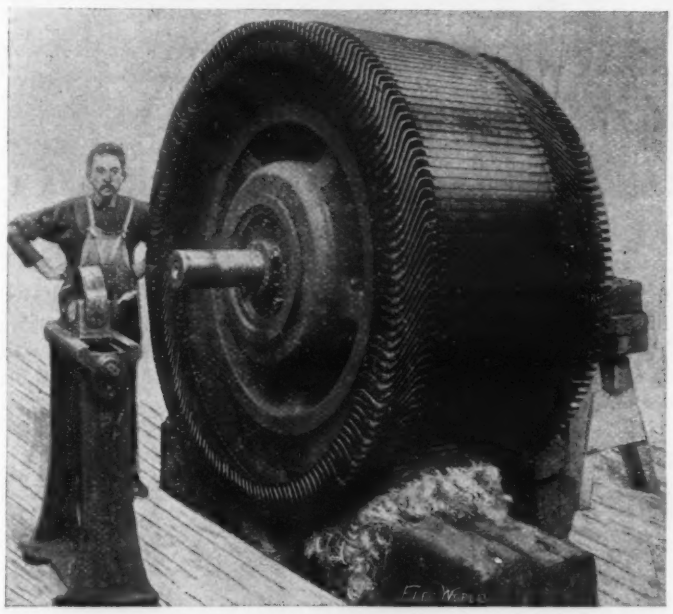
BORING A 1 000-HP ALTERNATOR FIELD, AND TURNING A 1,050-HP GENERATOR ARMATURE.

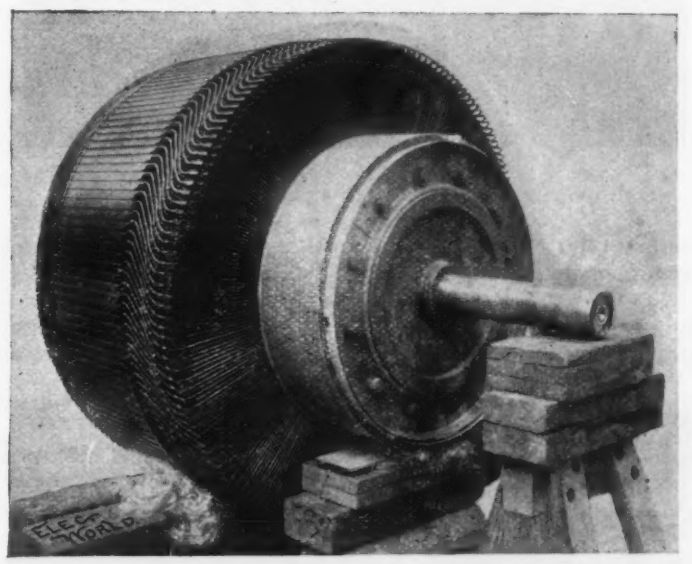


ONE OF THE PUNCHING PRESSES.

The organization of the employees is equally satisfactory. There is a head foreman in charge of each of the general sections, and under him assistant foremen for the sub-divisions into which the work is divided. The system under which the men work and earn their wages is best fitted to make them industrious and energetic, and that the relations between the employer and the employee are most friendly and satisfactory is attested by the evident good feeling which prevails throughout the factory. The whole system has been most thoroughly studied and admirably developed and adjusted to meet the conditions for manufacturing on a large scale. In fact, in examining the operations of the factory one is impressed with the military like organization which everywhere prevails.

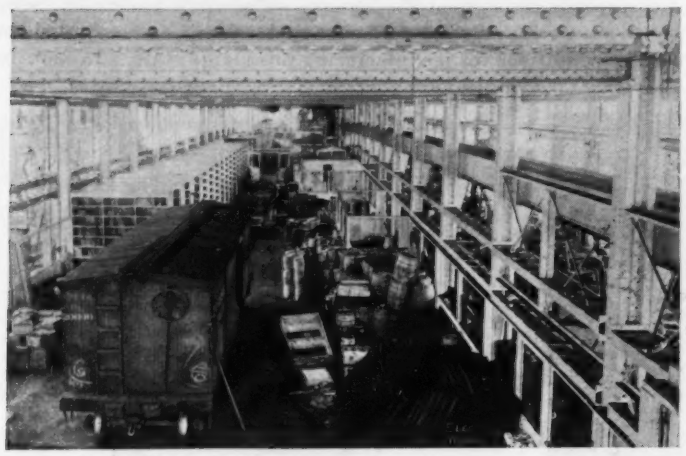
With many manufactures it is only necessary to assemble the various parts in order to complete the work, but with electrical apparatus it is essential that everything be thoroughly tested before shipment. The Westinghouse Company realizes the importance of this feature in its business and goes to a large expense and much trouble to make sure that each piece of apparatus shipped more than comes up to the requirements which it is expected to meet in actual operation. Not even a single piece of detail apparatus is sent to the shipper without being thoroughly tested. The company has organized a large corps of testers and inspectors, who follow the apparatus through its construction from the beginning to the very end. Tests are applied to various parts before assembling, and then the apparatus is tested as a whole. Records of the final tests are kept and filed, so that at any time it is very easy for the company to know just what any given piece of apparatus has done in its own factory.





1,050-HP DIRECT-CURRENT ARMATURE.

All shipments from the factory are made by the Pennsylvania Railway and the arrangements of each building are such as to allow the freight cars to be run directly within the building. Last fall when the main building was used for a reception extended to the



In the Shipping Department.

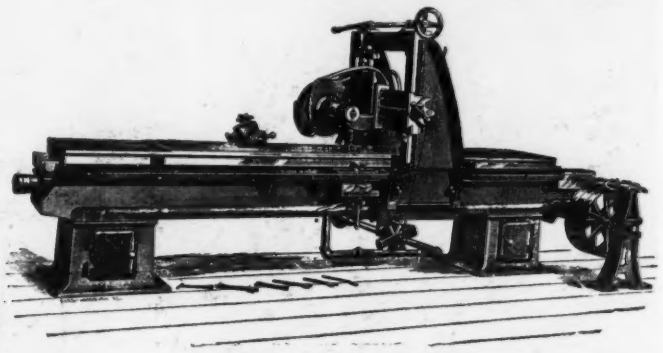
Grand Army of the Republic during its encampment in Pittsburg, the whole train load of invited guests was run right into the building, so commodious are the railway accommodations. As will be noticed in the principal view of the factories, both an elevated and grade-level track run along the south side of the warehouse, power house and punch departments, thus contributing in a marked

One of the East Pittsburg Club's Dining Rooms.

degree to the convenient and rapid reception and shipment of materials and apparatus throughout the works.

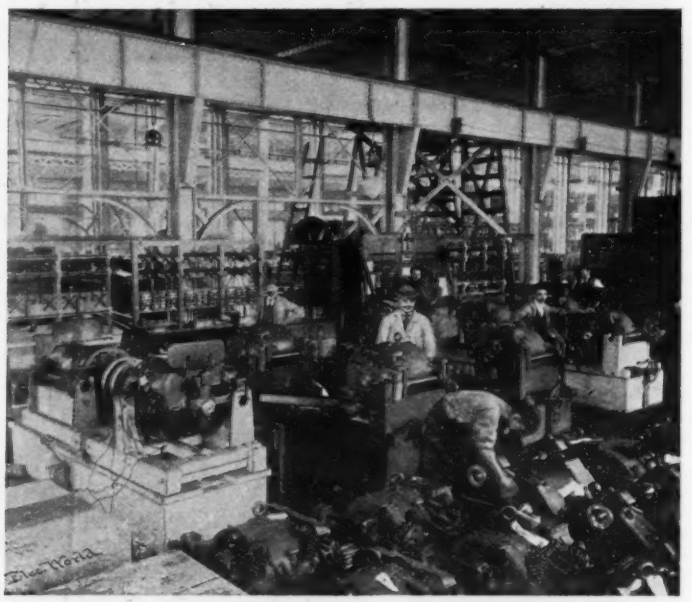
With the installation of the works at the new factory, the company has undertaken the manufacture of a larger line of electrical apparatus than has heretofore been attempted. Every form and size of motor and generator for direct, alternating and polyphase currents, from ⅛ to 5,000 horse-power, are now being regularly manufactured. The arc and incandescent lamp business has been extended to meet every conceivable want in this direction. Detail apparatus such as fan motors, meters, current indicators, switches, lightning arresters, ground detectors, etc., etc., have been perfected, and are being manufactured on the largest scale.

Through the generosity of the Westinghouse Company and some of its officers, there has been secured as a club house for the use of



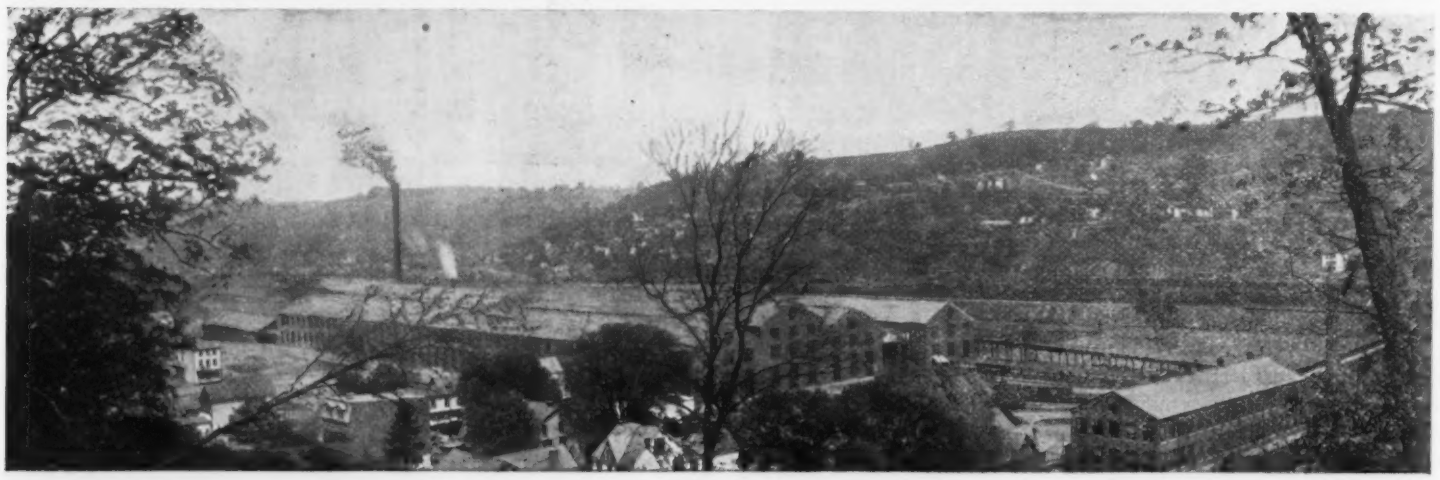
Emery Die Grinder.

office employees, a very attractive and convenient brick building within a few hundred feet of the factory. Here meals are served,



Section A.—Testing Street Car Motors.

and a glance at the photograph taken of the dining-room will give an idea of how comfortably and luxuriously the company provides for those in its employ. The club house is also furnished with sleeping rooms, etc., so that it is a convenient stopping place for either officers or guests of the company.



Electrodynamic Machinery.—XXXIX.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

265. In discussing the magnetic flux surrounding an active conductor we have observed in Par. 34, that it is distributed in concentric cylinders around the conductor, as shown in Figs. 27 and 28. It is evident that if a straight conducting wire AB, say l cms in length, as shown in Fig. 185, be situated in the uniform magnetic flux represented by the arrows, the flux will exert no mechanical influence upon the wire. If, however, the wire carries a uniform current in the direction of the straight arrows, then, as is represented diagrammatically in Fig. 186, the system of concentric circular flux shown by a single circle of arrows will be established around the wire, appearing clockwise to an observer looking from A, along the direction in which the current flows, and, as has already been pointed out, this circular magnetic flux will have an intensity proportional to the current strength.

266. If such a conductor be introduced into a uniform magnetic field, as is represented in Fig. 187, it is evident that above the wire

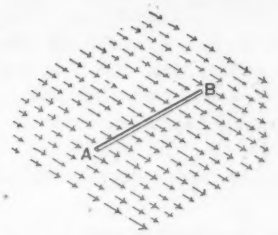


FIG. 185.—STRAIGHT CONDUCTOR IN UNIFORM MAGNETIC FLUX.

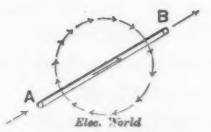
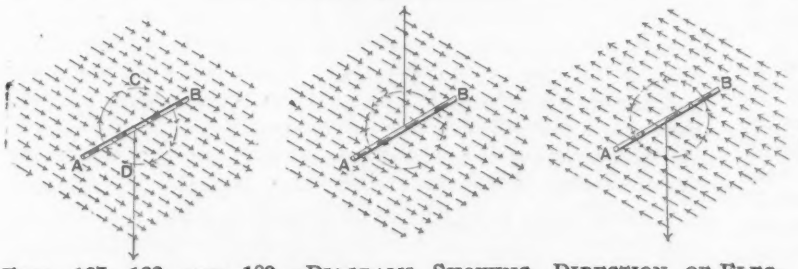


FIG. 186.—MAGNETIC FLUX SURROUNDING ACTIVE CONDUCTOR.

at C, the direction of the flux produced by the current is the same as that of the field, while below the wire at D, the direction of the flux from the current is opposite to that from the field. Consequently, the flux above the wire is denser, and that below the wire is weaker, or less dense, than that of the rest of the field. The effect of this dissymmetrical distribution of the flux density in the immediate neighborhood of the wire, is to produce a mechanical force exerted upon the substance of the wire, called the *electrodynamic force*, tending to move it from the region of densest flux toward the region of weakest flux; or, in the case of Fig. 187, vertically downwards, as indicated by the large arrow. If, however, the direction of the current in the wire be reversed, as shown in Fig. 188, and that of the external field remain unchanged, the flux will be densest beneath the wire and weakest above it, so that the electrodynamic force will now be exerted in the opposite direction, or vertically upwards, as shown by the large arrows.

267. If the direction both of the current in the wire and the flux in the external field be reversed, the direction of the electrodynamic force will not be changed, as is represented in Fig. 189, where the direction of the electrodynamic force is downward as in



FIGS. 187, 188 AND 189.—DIAGRAMS SHOWING DIRECTION OF ELECTRODYNAMIC FORCE.

Fig. 187, though the direction of the current and the direction of the magnetic field are both reversed.

268. A convenient rule for remembering the direction of the motion is known as *Fleming's rule*. It is, in general, the same as that already given for dynamos in Par. 70, except that in applying it, the left hand must be used instead of the right. For example, if the forefinger of the left hand shows the direction of the flux, and the middle finger the direction of the current, then the thumb will show the direction of the motion. It must be remembered, that in applying Fleming's rule, the right hand is used for dynamos in determining the direction of the induced E. M. F., and the left hand for motors in determining the direction of motion.

269. We shall now determine the value of the electrodynamic force in any given case, on the doctrine of the conservation of energy. To do this we may consider the ideal apparatus, represented in Fig. 190, where a horizontal conductor EF, moves without friction against two vertical metallic uprights AB and CD. This conductor is supported by a weightless thread, passing over two frictionless pulleys P, P, and bearing a weight W. If, now, a current enters the upright AB, and, passing through the sliding conductor EF, leaves the upright CD, at C, then, under the influence of the uniform magnetic flux passing horizontally across the bar in the direction of the arrows, in accordance with the preceding principles, an electrodynamic force will act vertically downwards upon the rod. If this electrodynamic force is sufficiently powerful to raise the weight W, it will evidently do work on such weight, as soon as it causes the bar to move. Let us suppose that it produces

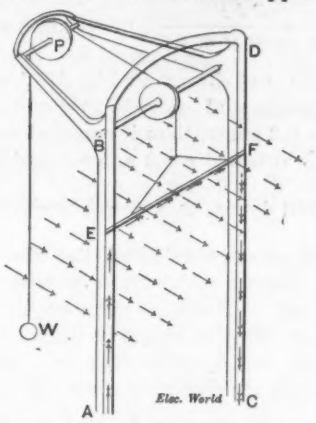


FIG. 190.—IDEAL ELECTRODYNAMIC MOTOR.

a steady velocity of the bar EF, of v cms per second, in a downward direction. Then if f, be the electrodynamic force in dynes exerted on the bar, the activity exerted will be, $v\,f$ centimetre-dynes per second, or ergs per second. Since 10,000,000 ergs make one joule, this will be an activity of

$$\frac{v\,f}{10{,}000{,}000}, \text{ joules-per-second, or watts.}$$

This activity will be expended in raising the weight W, assuming the absence of friction. As in all cases of work expended, the requisite activity to perform such work must be drawn from some source, and in this case the source is the electric circuit.

270. When the bar of length l cms moves with a velocity of v centimetres per second, through the uniform flux of density B, it must generate an E. M. F. as stated in Par. 71, of $e = B\,l\,v$, C. G. S. units, or

$$= \frac{B\,l\,v}{100{,}000{,}000} \qquad \text{volts.}$$

This E. M. F. is always directed against the current in the wire and is, therefore, always a C. E. M. F. in the circuit. The cur-

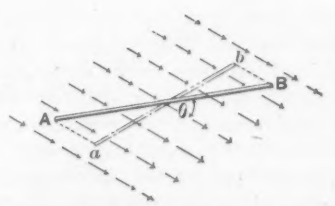


FIG. 191.—WIRE LYING OBLIQUE TO MAGNETIC FLUX.

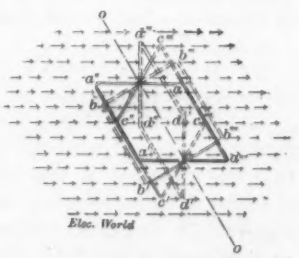


FIG. 192.—LOOP OF ACTIVE CONDUCTOR IN MAGNETIC FLUX.

rent of i amperes passing through the rod will, therefore, do work upon this C. E. M. F. with an activity of

$$e\,i \text{ watts} = \frac{B\,l\,v}{100{,}000{,}000} \cdot i \qquad \text{watts.}$$

This activity must be equal to the activity exerted mechanically by the system, so that we have the equation,

$$\frac{v\,f}{10{,}000{,}000} = \frac{B\,l\,v\,i}{100{,}000{,}000}$$

From which,

$$f = \frac{B\,l\,i}{10} \qquad \text{dynes.}$$

$\frac{i}{10}$ will be the number of C. G. S. units of current, since the C. G. S. unit of current is 10 amperes, so that the fundamental expression for the electrodynamic force exerted on a straight wire, lying or moving at right angles across a uniform flux, is

$$f = B\,l\,I \qquad \text{dynes,}$$

where I, is expressed in C. G. S. units of current. Since 981 dynes are, approximately, the force exerted by gravity upon one gramme, we have

$$f = \frac{B\,l\,I}{981} \text{ or } \frac{B\,l\,i}{9810} \qquad \text{grammes weight,}$$

and since 453.6 grammes make one pound, f, expressed in pounds weight will be

$$f = \frac{B\,l\,i}{10 \times 981 \times 453.6} \qquad \text{pounds weight.}$$

If, for example, the rod shown in Fig. 190 had a length of one metre, or 100 centimetres, and moved in the earth's flux whose horizontal component = 0.2 gauss, then if supplied with a uniform current of 1,000 amperes it would exert a downward force of

$$0.2 \times 100 \times \frac{1000}{10} = 2000 \text{ dynes, or, approximately, 2 grammes weight.}$$

271. We have heretofore considered the wire as lying at right angles to the flux through which it is moved. If, however, the wire AB, lies obliquely to the flux, at an angle θ, as is represented in Fig. 191, then the effective length of the wire, or the projected length of AB, at right angles to the flux will be $a\,b$. In symbols this will be $l \sin \theta$, and the electrodynamic force will be

$$f = B\,l \sin\theta \frac{i}{10} \text{ dynes.}$$

272. Although such a machine as is represented in Fig. 190 is capable of performing mechanical work, and might be, therefore, regarded as a form of electrodynamic motor, yet all practical electrodynamic motors are operated by means of conducting loops, capable of rotating about an axis. We shall, therefore, now consider such forms of conductor.

273. If the rectangular loop $a'\,a''\,a'''\,a^{iv}$, placed in a horizontal plane, in a uniform magnetic flux, be capable of rotation about the axis 00, then if a current of i amperes be caused to flow through the loop in the direction $a'\,a''\,a'''\,a^{iv}$, electrodynamic forces will be set up according to the preceding principles upon the sides $a'\,a''$, and $a'''\,a^{iv}$. There will be no electrodynamic force upon the remaining two sides. Under the influence of these electrodynamic forces, the side $a'\,a''$, will tend to move upwards, and the side $a'''\,a^{iv}$, downwards. The loop, therefore, if free to move, will rotate and will occupy the successive positions b, c and d. At the last named position, the plane of the loop being vertical, although the electrodynamic force will still exist, tending to move the side $a'\,a''$, downwards and the side a''', a^{iv} upwards, yet these forces can produce no motion, being in opposite directions and in the same plane as the axis; or, in other words, the loop considered as a rotatable system is at a dead point.

274. It is clear, from what has been already explained, that if the direction of the current in the loop had been reversed while the direction of the field flux remained the same, or the direction of the field flux reversed with the direction of current remaining the same, that the direction of the electrodynamic forces would have been changed, tending to move the side $a'\,a''$ upwards and the side $a'''\,a^{iv}$ downwards, so that the loop would have rotated in an opposite direction until it reached the vertical plane. Consequently, when a loop, lying in the plane of magnetic flux, receives an electric current, it tends to rotate, and it will, if free, rotate until it stands at right angles to the magnetic flux.

275. An inspection of the figure will show that when the loop is in the plane of magnetic flux, that is to say, when the rotary electrodynamic force is a maximum, the loop contains no magnetic flux passing through it, while when the loop is in the vertical position, and the rotary power of the electrodynamic force is zero, it contains the maximum amount of flux passing through it. The effect of the electrodynamic force, therefore, has been to move the conducting loop out of the position in which no flux passes through it into the position in which the maximum of flux passes through it possible under the given conditions.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia, Pa.

Rope Driving.—XXI.

BY J. J. FLATHER.

In the actual construction the centre of bolts must be placed at some distance from the point of application, in which case the bolts are subjected to an additional strain due to the bending moment at the joint as shown at (c) Fig. 63; if this bending moment is taken up by the rim, the bolt section will be $\frac{S}{f}$ as before; but if the rim and bolt flanges are rigid and resist any deformation the total strain comes upon the bolts; under these conditions the net section A may be obtained by multiplying $\frac{S}{f}$ by the ratio of the leverage y, of the force S to the leverage x, of the resistance in the bolt; hence, if we assume that $x = \frac{1}{2}\,y$, a common value, we shall obtain $A = 2\frac{S}{f}$. By using studs with nuts at each end the bolt may be placed nearer the rim, in which case, for the same depth of flange, the ratio $\frac{y}{x}$ may be diminished.

In order to obtain ample strength at the rim the bolt section should be determined on the supposition that the full bending moment will be thrown upon the bolts; in this case the bolt-flanges or lugs must be able to resist any bending due to the force S.

The bolt-flanges will be as strong as the rim if we make the respective moments of resistance equal to each other; hence, if

b = face of wheel;
b' = breadth of bolt-flange minus the width of bolt-holes;
t = mean thickness of rim;
t' = thickness of bolt-flange or lug;

then $\frac{1}{6}\,b\,t^2 f = \frac{1}{6}\,b'\,t'^2 f$ or

$$t' = \sqrt{\frac{b\,t^2}{b'}}$$

this thickness t' may be reduced somewhat if strengtheniug ribs

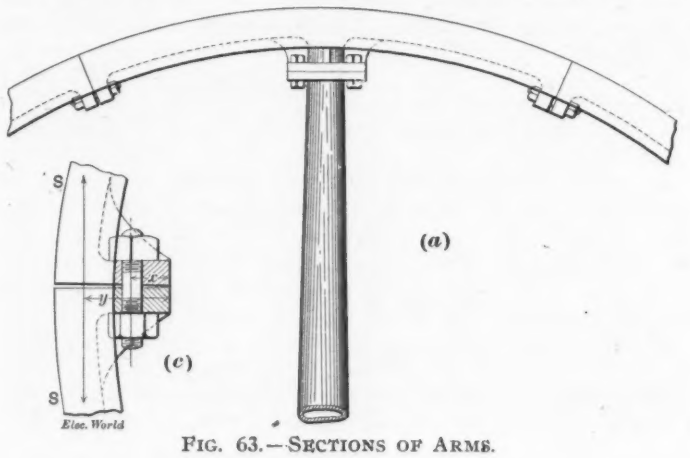


FIG. 63.—SECTIONS OF ARMS.

are carried from the rim to the lower edge of the bolt-flange, as shown at (c), Fig. 63. In the above, t was taken as the mean thickness of rim reduced to a rectangle, and no account has been taken of the strengthening ribs and flanges.

If the leverage of the bolts is assumed as ½, we may obtain the total net section of the bolts as follows:

$$A = \frac{2\,S}{f} = \frac{1}{f}\left(\frac{F_0}{\pi} + \frac{W}{2}\right);$$

since $F_0 = 0.00034\,W\,R\,N^2$,

$$A = \frac{1}{f}\left[0.000108\,W\,R\,N^2 + \frac{W}{2}\right]$$

In the above formula f may be taken equal to 6,000 pounds ordinarily, but for large bolts 8,000 to 9,000 pounds may be used.

If t = the mean thickness, and b = breadth of rim, both in inches, the weight W may be determined from

$$W = 2\,\pi\,R \times 12\,t\,b \times 0.26 = 19.6\,R\,t\,b.$$

If the rim is properly bolted the principal strains to which the hub bolts are subjected are those due to the weight of hub and arms and the tension produced by keying to the shaft.

As the weight of hub and arms in large pulleys is usually much less than the weight of rim, it will be seen that the strain on the hub bolts due to the weight and centrifugal force of these parts will be less than that on the rim bolts.

In practice some makers design the hub joint so that the net section of all the bolts is equal to the bolt section in one edge of the rim joint; this, however, is not usual practice.

An inspection of a great many pulleys made by various manufacturers shows that the hub-bolt section is often twice as great as the rim-bolt section; but in many of these cases the rim bolting is very weak.

It is safe to make the bolt area the same in each case; but if the rim joint be made according to the method indicated, the bolts in the hub will usually be sufficiently strong if their total effective section is equal to that in one rim joint. For light pulleys, however, this should be increased.*

The section of arm for those pulleys in which the arms and hub are cast together is usually elliptical or segmental, as shown in Fig. 64.

The elliptical form as here given is so proportioned that its minor axis is one half its major; in the segmental form the minor axis is four tenths the major. The cross-section of the arm may be determined by considering it as a beam fixed at one end and loaded at the other with the force P due to the pull of the ropes. The bending moment on each arm will then be

$$M_b = \frac{P r}{N_a}$$

assuming that the load is divided equally among the number of arms N^a.

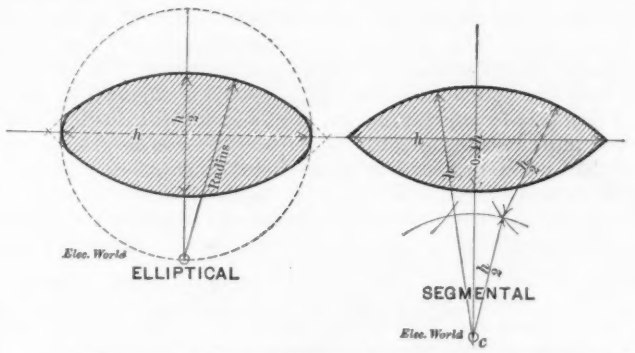


FIG. 64.—METHOD OF JOINING ARMS AND RIM.

Since the bending moment is equal to the modulus of the section Z, multiplied by the stress f in the material, we have

$$M_b = f Z;$$

for an elliptical section whose major axis is h and minor axis $0.4\,h$, $Z = \frac{\pi}{32} h^2 \times .4\,h$, hence, $\frac{Pr}{N_a} = f \times \frac{\pi}{32} \times .4\,h^3$. [1]

If we let T_1, the maximum tension in the rope, equal $200\,d^2$ pounds, and $\frac{T_1}{T_2} = 2$, we shall have the load acting on each arm

$$P = 100\,d^2\,n$$

where n is the number and d the diameter of ropes. Therefore, by substituting the value of P in equation [1] there is obtained

$$h = \sqrt[3]{\frac{100\,d^2\,n\,r}{0.04\,f\,N_a}}$$

assuming that $f = 2{,}500$ pounds per square inch for cast-iron, and that N_a equals 6, we have $h = 0.44\sqrt[3]{d^2\,n\,D}$, where D = pitch diameter of pulley in inches and h is the major axis of arm produced to centre of wheel.

As the smaller pulleys require a larger margin of strength, on account of their greater liaoility to breakage in handling and casting, the above formula should be modified by introducing a constant; if we let this constant equal one half inch a suitable value for the width of arm will be obtained from

$$h = 0.44\sqrt[3]{d^2\,n\,D} + 0.5''. \qquad [2]$$

As the centrifugal force set up in the rim of the pulley causes an additional stress in the metal, the value of f should be chosen with reference to the speed at which the pulley is to run.

The higher speed not only induces a greater stress in the material, but the liability of failure due to vibration or shocks is greatly increased.

* For complete analysis of strains in fly-wheel rims see Prof. Unwin's "Machine Design," Vol. II. Also Mr. Stanwood's paper in Vol. XIV. Trans. A. S. M. E., with Prof. Lanza's discussion on same.

The stress in the rim due to centrifugal force may be obtained by considering the pulley as a cylinder subjected to a force p ($= F_0$) per square inch. The thickness of a thin cylinder to resist rupture may be obtained from $t = \frac{p\,D}{2f'} = \frac{p\,r}{f'}$

in which t = thickness in inches
p = pressure per square inch;
r = radius of cylinder in inches;
f' = allowable stress in pounds;

in this case $p = F_0 = \frac{W v^2}{g R}$

where W = weight in pounds = 0.261 pounds per cubic inch;
v = velocity of rim in feet per second;
g = 32.16;
R = radius of rim in feet = $\frac{r}{12}$;

hence $t = \frac{F_0\,r}{f'} = \frac{W v^2}{g R} \times \frac{r}{f'} = \frac{W v^2 \times r}{g f' \times \frac{r}{12}}$

and $f' = \frac{12\,W v^2}{g\,t}$

If the centrifugal force act on one square inch of pulley whose thickness is unity, we shall have

$$f' = \frac{0.261 \times 12\,v^2}{32.16} = 0.097\,v^2$$
$$= \frac{v^2}{10} \text{ very nearly.}$$

This is the stress in rim per square inch of section due to centrifugal force alone.

When v in feet per second = / When V in feet per minute =	50 / 3000	60 / 3600	70 / 4200	80 / 4800	90 / 5400	100 / 6000	150 / 9000	200 / 12000
Stress f' in pounds due to centrifugal tension = ...	250	360	490	640	810	1000	2250	4000

The stresses due to the pull of the ropes, and those due to contraction in cooling are additional to those here given, hence f should be taken sufficiently low to allow for the various stresses which may be set up in the pulley.

If we assume that the working stress in the arms should not ordinarily exceed 3,500 pounds per square inch for cast-iron, and that it should be less for high speeds where the dynamic effect of shock and vibration is greater, a suitable value may be obtained from the empirical formula $f = \frac{50000}{5 + \sqrt[3]{V}}$.

From this formula the annexed values of f have been calculated. It will be noticed that the value of f used in formula [2], namely, 2,500 pounds, corresponds to a velocity of rim equal to about 3,500 feet per minute.

Velocity of rope in ft per min. V =	1200	1800	2400	3600	4800	6000
Allowable stress f = ...	3200	2900	2700	2450	2300	2150

The arms should taper toward the rim $\frac{1}{16}$ inch per inch of length, that is, $\frac{1}{32}$ on each side, but in no case should the width of arm at the rim be less than two thirds its width at the centre of shaft.

Very wide pulleys in which the proportions for single arms would be inconveniently large may be made with two or three sets of arms; in such cases they may be considered as two or three separate pulleys combined in one, except that the proportions of the arms should be 0.8 to 0.7 times that of single arm pulleys.*

In designing the hubs of wheels practice varies considerably. Some authorities give the thickness of metal around the eye in terms of the pulley diameter only, others take into account the diameter of pulley and also the diameter of shaft, or the breadth of face, while the length is variously given in terms of the diameter of shaft, or the face of pulley or both.

For rope pulleys, if the thickness of metal in the hub is made proportional to the diameter of pulley, and also to the diameter of shaft; and if the length of hub is made to vary with the number

*" Reuleaux Constructeur."

and size of ropes and the diameter of shaft, we believe the requirements of strength and good proportions will be best attained.

Let D — diameter of pulley in inches;
d_s — " " shaft " ;
d_h — " " hub; " ;
d — " " rope " ;
n — number of ropes;
and L_h — length of hub;

then the diameter and length of hub may be obtained from the following formulæ, which have been deduced by the writer from the proportions of a large number of rope pulleys made by representative manufacturers:

$$d_h = 0.025\,D + d_s + 2\tfrac{1}{4}''$$

and

$$L_h = 0.6\,d\,n + d_s + \tfrac{3}{4}\ ''$$

For loose or idle pulleys the diameter of hub may be made less than that given by the above formula which allows for keying; in general the thickness of metal around the eye in an idle pulley may be taken as about two thirds as great as that in fixed pulleys of same diameter and face.

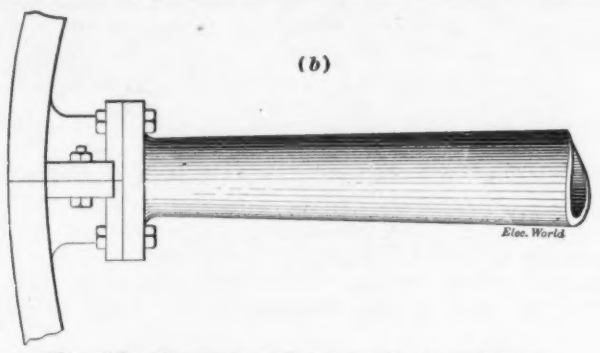


FIG. 65.—METHOD OF JOINING ARMS AND RIM.

The length of hub in idlers should be sufficient to give a good, bearing surface, and may vary from two to three times the diameter of shaft—depending somewhat upon the speed of rotation.

In the construction of large rope pulleys which are made in segments, the usual method is to bolt the rim sections to the arms at the ends of the segments, as shown at (*b*) in Fig. 65.

When the rim segments are joined midway between the arms as at (*a*), the several connections are simplified to some extent, but with this method of connection there is a decided tendency for the joint to open under the influence of centrifugal force which is increased somewhat by the weight of the connecting flanges and bolts. With the rim joints at the junction with the arms, however, a rigid connection between adjacent arms is obtained, and the centrifugal effect of the rim tends to increase the tension in the arm without opening the joint.

Electric Shock from a Secondary Alternating Current.

A writer in a recent issue of the New York ELECTRICAL WORLD records several instances of men who received severe shocks while standing on damp earth engaged in turning on lamps supplied from secondary alternating circuits. In one of the instances quoted, the ground detector at the station showed a ground on the line, and upon examination two transformers were found to be burnt out. In another case a man was instantly killed as he reached to turn on the light above his head; an employee afterward was trying to explain the accident to some one, and upon touching a snap switch, and the floor being damp, he was thrown some distance and badly burnt. An examination of the transformer showed a ground of one primary and one secondary wire on the case. In another case, on the same company's circuit, a servant girl stood in her slippers on a damp cement floor and was hurled to the ground senseless by the shock received. An identical instance is recorded of a boiler engineer. The writer thinks of grounding the secondary wire to earth, though, as he has never heard of it before, he is nervous of the probable results. A correspondent writing to us on the subject, says: "It seems to me that the cure for accidents of this kind lies in the use of earthing devices of the Cardew or other types, which will put the secondary circuit to earth automatically, should the secondary E. M. F. from any reason rise above the normal to any great extent. In Scarborough we have one of these earthing devices connected to every transformer, and I think it is a wise precaution to adopt."—*London Electrical Review.*

Electrocution Vindicated.

We are glad, says the London *Electrical Review*, to compliment our contemporary, THE ELECTRICAL WORLD, on the stand it is making against the cheap sensationalism which other American technical journals have permitted to invade their columns in respect to the subject of electrocution. In a recent issue it published a report of a meeting of the New York Prison Association. At this meeting Dr. A. H. Goelet gave an account of his observations at the recent execution of a negro murderer at Sing Sing. In referring to the controversy recently excited by D'Arsonval's statement that the electric current as employed in the New York State Prisons does not inflict absolute death, Dr. Goelet ascribed it as partly due to the apparently negative results of the official examinations of the bodies of the first six criminals executed. Had the official pathologist, he said, who assisted at the post-mortems, not limited his examination of the brain to one case, he would have been able to have discovered what has now only three years later been demonstrated. A report prepared by Dr. T. E. Oerte on a microscopical examination of the blood and tissues of an executed criminal, was then submitted. From this we gather that (1) The chief action of the current is upon the blood and blood vessels; (2) The red corpuscles have less resistance than the white; (3) One or more of the elements determining coagulation of the blood is destroyed; (4) A germicidal agent is formed in the blood, which precludes the continued existence of multiplication of putrefactive organisms; (5) The liver is the organ most affected; (6) The lungs offer the most resistance; (7) The force exerted is sufficient to rupture the brain tissues and smaller vessels of the brain, and to produce universal hemorrhage in its substance; (8) The cellular elements of the tissues are not apparently destroyed; (9) The deviations from the normal conditions thus noted are sufficient to produce lethal results. In conclusion, Dr. Goelet states that death is instantaneous and painless, the latter being true because electricity travels faster than the nerves can transmit painful impulses. Hence, we may confidently claim that if murder, as the law declares, must be expiated by the death penalty, electricity should be universally adopted as a method of accomplishing this in the most humane manner. But what will the *Lancet* say?

Recent Patent Decisions.

To the Editor of The Electrical World:

SIR:—In reading the editorial entitled "Recent Patent Decisions," in the issue of the 8th instant of THE ELECTRICAL WORLD, we note the following sentence:

"If the foreign patent is granted to the second inventor prior to the application for a domestic patent by the first inventor, it constitutes publication, and, therefore, bars the latter from obtaining a patent regardless of priority of invention."

If this means that a United States patentee is barred from obtaining a patent by the issuance of a foreign patent to a subsequent inventor this statement does not seem to be in accordance with Rule 75 of the Rules of Practice, and the particular section of the statute upon which it is based, with both of which you are no doubt familiar. If, however, the sentence quoted refers to domestic patentees for *foreign* patents, the sentence quoted seems to be in accordance with the following sentence taken from the decision of Lauder vs. Crowell et al., 1879, 16 O. G. 405:

"When two applicants for patents for the same foreign invention, of whom only one is a foreign patentee, are before the Patent Office of the United States, the foreign patent of one of the applicants is a bar to the issue of an American patent to the other, even though he is in fact the prior inventor."

We do not take the time to call your attention to any other decisions on this point as it is our impression that the sentence quoted is not exactly as you intend it, and we suppose, of course, that if this is so you will be pleased to have us call your attention to this matter. HEY & PARSONS.

SYRACUSE, N. Y.

[That part of rule 75 of the Rules of Practice of the United States Patent Office, referred to above, is as follows: "When an original or reissue application is rejected on reference to a foreign patent or to a printed publication, and the applicant shall make oath to facts showing a completion of the invention in this country before * * * the date of the foreign patent, or before the date of the printed publication, and shall also make oath that he does not know and does not believe that the invention has been in public use or on sale in this country for more than two years prior to his application, then the patent or publication cited will not bar the grant of a patent to the applicant."]

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut Street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Theory of Dynamos.—Some of the formulæ from Mr. Farman's article, abstracted in the Digest, March 30, are given in the "Jour. Inst. Elec. Eng." for May.

Improvements in Armature Ventilation.—Prof. Ryan's paper from the "Sibley Jour." for April, is reprinted in abstract in the Lond. "Elec.," May 31, and is editorially discussed.

Thompson and Ryan Dynamo.—An illustrated description showing the details of a dynamo designed by Mr. Thompson and Prof. Ryan in accordance with the principles described in their recent Institute paper, is published in "Elec. Ind." for June. The machine shown has a capacity of 100 kw, is direct-connected and is to be installed in a store in Chicago the total weight is 6,000 pounds, equivalent to 16.7 watts per pound, it is multipolar and contains a pole ring around the pole pieces which contains the balancing coils whose purpose is to balance the magnetic effect of the armature and produce the proper field for perfect commutation and to afford what little compounding is needed; these coils prevent the usual distortion of the field due to the armature reaction and enable the full magnetic strength to do effective work; they form the chief novel feature of the design; there is said to be a great reduction in size secured by the greater efficiency of the fields; the slots in the armature core are deeper than usual and the windings consist of heavy strips of copper; it is unnecessary to adjust the brushes for different loads and there is said to be a remarkable absence of sparking; the makers claim that the saving in material more than makes up for the extra expense of the complications.

LIGHTS AND LIGHTING.

Artificial Lighting from a Hygienic Standpoint.—The "Zeit. f. Beleucht.," May 30, contains an article of some length by Dr. Ploetz. He points out the importance of considering the hygienic effect of artificial lighting and discusses the well-known requirements giving comparative data of various kinds for the different illuminants (the authorities for which, however, are not given). The following figures contained in his article may be of interest. The artificial lighting in Paris per year and per capita in 1855 was 3,765 candle-hours and in 1889, 11,302; the minimum illumination of an object should be 10 metre candles; the illumination below a small light which, without a reflector or globe, is one metre candle, can be increased to 23 by a paper reflector, to 30 by a white glass reflector, to 64 by a polished reflector and to 260 by a hemispherical reflector (of silvered glass?). He gives the brightness, that is the number of candles per sq. cm of surface of the source of light, as follows: the sun 5,300, the arc light 500, the incandescent light 40, the Welsbach light 1.2, large regenerating burner 0.60, Argand burner 0.3, ordinary gas burner 0.06. The amount of heat generated per hour per 100 candles is given for a number of lights, that for the arc light is 57 to 158, for the incandescent light 290 to 536, Welsbach light 1,060, gas burner 12,150; the amount of carbonic acid gas given off per hour by an Argand burner of 100 candles is 0.46 cb. meters, by the Welsbach burner 0.23, while that given off per hour by a human being is 0.02; air containing 0.5 parts carbon monoxide in a thousand is considered dangerous while 0.2 parts is harmless. His conclusions are that from a hygienic standpoint the best lights are the arc and the electric incandescent light, but that one should strive to produce greater uniformity in the illumination from these lights; next to this comes the Welsbach light.

Train Lighting.—In Mr. Weekes' serial in the Lond. "Elec. Eng.," May 31, he gives a detailed and well-illustrated description of the system which was used on the Midland Railway, but has since been abandoned although it is said to have been a success.

Electric Light on the Suez Canal.—According to the Lond. "Elec.," May 31, 3,352 ships passed through the canal in 1894, of which 3,180 made the journey at night by the aid of the electric light; the average time of transit is 20 hours.

Economy in Arc Lighting.—In an editorial in the "Electrical Jour.," June 1, Prof. Carhart points out the recent distinct advances in arc lighting which he says are the increase in the number of closed-coil Gramme-ring dynamos, the improvement in arc lamps and the introduction of much larger machines; very extensive comparisons of cored and common carbons, he states, have demonstrated that the best cored carbons give 10 per cent. more light than the others for the same number of watts; they do not require more than 40 volts.

Arc Lamp for Constant Potential Circuits.—The Rushmore system is briefly described and illustrated in the "Elec. Eng.," June 12; two lamps are connected in series, the novel feature consisting in using an additional shunt coil in the lamp, opposed to the regular one but connected to the other lamp; the effect of the arrangement is to make each lamp dependent on the other and to entirely prevent seesawing and jumping; an additional advantage is that ordinary American carbons can be used while in the incandescent arc lamp it is claimed that expensive foreign carbons must be used; the present arrangement requires the use of two additional wires connecting the two lamps.

Visibility of Lights.—According to some recent experiments made by the governments of the United States, Germany and the Netherlands, mentioned briefly in the "Eng. News," June 13, a 1-cp white light is visible at a distance a little more than a mile, one of 3-cp is visible at two miles; on an exceptionally clear night a white light of 3.2-cp was readily distinguished at three miles; one of 5.6-cp at four miles, and one of 12.2-cp at five miles; a green or red 2-cp light was visible at one mile, 15-cp at two miles, 51-cp at three miles and 106-cp at four miles.

POWER AND HEAT.

Slavianoff Electric Casting Process.—The "Elek. Zeit.," May 30, contains a long illustrated article by Mr. Lohmann describing in detail the Slavianoff process, a description of which was given in the Digest, April 6; some illustrations of the applications were referred to in the Digest last week. The process has been in use for a number of years, chiefly for making repairs of large pieces of machinery, and it is believed that it will be used largely in the future; in this process the metal is melted by the arc in the place where it is required to be cast, one of the electrodes being made of the metal to be melted, and the other being the piece to be repaired. The apparatus for automatically regulating the length of the arc is well illustrated and consists essentially of an apparatus resembling in principle that used in some arc lights; the electrode which forms one of the terminals of the arc and which is melted to supply the metal, is in the form of a rod which is fed by hand, but its distance from the other electrode is regulated by this automatic device, which consists essentially of a series coil having a movable core which, by means of a bent lever, regulates the length of the arc, the whole apparatus being suspended from the ceiling; when several of the mechanisms are to be used in series, a shunt coil is added making a differential action; there is also in circuit a resistance for adjusting the current and a commutator for reversing it, which latter is a very important feature in this process; there is about twice as much heat developed on the positive pole as on the negative, and the positive is therefore made the electrode on which the greatest heat is to be developed; if the movable electrode is to be melted as fast as possible it is made the positive pole; if on the other hand the piece unto which the metal is to be cast, is to be superficially fused in order to assure a union with the molten metal, it is made the positive pole. The chemical action must also be considered and in this connection practice has shown that in melting cast iron the movable rod must be made positive; if the current flows in the reverse direction a white, hard cast iron containing little carbon, is produced; the current must be proportioned to the size of the movable electrode; 7.5 to 8 amperes per sq. mm are used, and the voltage is in all cases from 50 to 70; the smallest rods to be used are 6 mm in diameter (about 1¼ in.). A battery of accumulators is not necessary if the dynamo is sufficiently strong to stand the variable currents and if its armature is not too sensitive. The method has been used by the Pintsch Company of Berlin, for the past 2.5 years; casting the metal by this means is of course more expensive than by the usual methods, but the system is applicable in such cases where the cost of fusing the metal is of small importance. The following are some of the applications: small objects may be cast by melting the metal in a graphite crucible in which the arc is formed and in which the molten metal from the positive electrode is collected; cracks in metal pieces

can be mended; broken pieces can be joined together; blow holes are easily filled out; worn surfaces can be renewed by casting new metal on them; various metals can be united by casting one on the other, as for instance, cast iron on steel, copper and bronze on cast iron, steel on wrought iron or hard on soft cast iron; holes made by mistake in valuable castings can be filled out; faulty welds can be repaired; parts broken off from castings replaced; hard white cast iron can be converted into soft grey cast iron. It is very essential that the parts to be repaired must first be prepared; in the case of a crack for instance, it must be cut out so as to make room for the new metal; the piece to be mended must first be heated by means of the arc and in some cases a mould must be made; for the latter, retort carbon is used if the metal is cast iron; if the latter is to be poor in carbon, quartz sand is used or the current is reversed; sand is used for casting steel or wrought iron; both materials may be used for copper and bronze; there is an appreciable amount of oxidation and a flux must therefore be used; the preliminary heating is done by means of the arc and on it much of the success depends; for cast iron the electrode to be melted is a rod 1½ yards long consisting of 100 parts of ordinary cast iron and 13 parts of silicate of iron; small pieces of metal may be thrown into the molten mass; for cast iron the movable electrode is made positive but for steel or wrought iron it is made negative; for a flux, powdered glass is used, together with ferro-manganese or chrom iron. For casting copper the movable electrode is made negative as also when this metal is cast on wrought iron or steel, but if cast on cast iron the copper is made positive. The structure of the cast metal is not as good as that of rolled or hammered iron or steel but it is as good as that of cast metals; if, however, it is hammered, a very fine structure is given to it. For converting hard, white cast iron into grey cast iron, a small amount of cast iron is cast on the surface and the molten metal is then heated for some time with an arc formed with a carbon electrode; by this means the carbon in the iron may be increased to any desired amount. In conclusion it is stated that in most cases the cost of making repairs with this system is far less than that of making a new piece, and a very valuable feature is that the time for making the repair is quite short; the process is therefore very valuable on board of ships. Several illustrations of repaired pieces of machinery are given, among them is the main casting of a Westinghouse steam engine in which a large piece had broken off.

Tempering of Steel.—A Physical Society paper by Mr. Charpy is abstracted in "L'Ind. Elec.," May 25, and in the Lond. "Proc. Phys. Soc." for June; he gives the results of a study of the physical and chemical transformations taking place in tempering steel, in which experiments the heating was done by an electrically heated platinum wire and the temperatures measured by a Le Chatelier pyrometer.

Transmission Plant at Aubervilliers.—An illustrated description of a private plant in this city in France in which gas engines supplied by producer gas are used, is published in "L'Ind. Elec.," May 25; it is really a power distribution plant as the distances are short; a table of the results of tests is given from which it appears that the coal consumed per horse-power-hour at the brake was 1.45 pounds for a mean brake power of 80.25 hp. A brief description of this plant is published in the "Elec. Eng." (N. Y.), June 5.

Transmission of Power by Synchronous Motors.—A translation of Mr. Picou's paper (see Digest, March 30, also June 1), is given in abstract in the "Jour. Inst. Elec. Eng." for May.

TRACTION.

Mountain Climbing Railways.—Mr. Scott's long article is concluded in the Lond. "Elec. Eng.," May 31; he describes several other railways and gives two tables, one containing a list of all existing mountain railways, 47 in number, and the other giving particulars about a number of these; he also gives the bibliography on the subject in the form of a long list of references.

Electric Traction in Europe.—A very long abstract from the report of Mr. Van Vloten (made about a year ago) is published in the "Bul. Soc. Belge d'Elec." for January, February and March; it is a general discussion of the subject of electric railways with special references to those in Europe; the costs of operation of a number of European lines are given.

Accumulator Traction.—"L'Ind. Elec.," May 25, gives some additional descriptive matter with illustrations of the plant in Paris, a description of which was given in the Digest, June 1; the present portion refers to the accumulators and the new form of cars but contains little more than has already been noticed in these columns.

Boston.—"L'Eclairage Elec.," May 18, contains a long, well-illustrated article by Mr. Pellissier on electric railways in Boston.

Interurban Electric Railway.—The paper by Prof. Short, mentioned in the Digest, June 15, is reprinted, apparently in full, in the "St. Ry. Jour." for June; a set of curves showing the efficiency and other features of a double 50-hp motor equipment and another of a double 100-hp motor equipment, are given.

Locating Faults in Track Circuits.—A description of the method of Mr. Henry (see Digest, June 15), is given more fully in the "St. R'y Gaz.," June 8.

Surface Contact System.—The system of the Electro-Magnetic Traction Co. (otherwise known as the McLaughlin system) is described and well illustrated in the "St. Ry. Jour." for June; there is a central sectional rail between the tracks which is stitched into the circuit as the car passes over it.

Conduit Railways.—In a short paper by Mr. Levy, reprinted in "Elec. Age," June 8, he discusses and criticises different systems.

Speed Indicator.—A system devised by Mr. Darley is described and illustrated in the "St. Ry. Gaz.," June 1; a dial indicates that the speed is greater than a pre-determined amount, thus serving as a check on the motorman.

Cast Welded Rail Joint.—In a brief description of the Falk process (see Digest, Jan. 5), in the "St. Ry. Jour." for June, an illustration is given of the new form of the complete outfit.

Practical Notes for Motormen.—A series of practical articles by Mr. Hanchett is begun in the "St. Ry. Gaz.," June 1; the object is to explain in a clear and simple manner the properties of electricity as applied to railway cars; it will include practical hints as to the method of handling the energy; it is intended for motormen who have no knowledge of electricity; in the first instalment a simple water analogy is given.

Street Railway Troubles.—The "Electrical Jour.," June 1, contains an article of an elementary nature by Mr. Shepherdson on this subject in which he discusses, in a practical way, troubles due to wear and depreciation and those due to accident and unusual causes.

Motor Repairs.—In Mr. Shepherd's series of articles he discusses the General Electric motor in the "St. Ry. Jour." for June.

Electric Railways in Great Britain.—The "St. Ry. Gaz.," June 8, contains a short article by Mr. Bridge giving a brief summary of the electric railways and railroads in England; he believes that the chief reason why England has been so slow in adopting electric railways is that investors delayed operations in order to take advantage of improvements.

Metropolitan Elevated Railway.—Some additional illustrations and descriptions of details are given in the "St. Ry. Gaz.," June 1. An illustrated description of this road is published in "Elec. Ind." for June.

Philadelphia.—The "St. Ry. Gaz.," June 1, gives a series of well-illustrated articles describing the Hestonville, Mantua & Fairmount Co.'s plant, in which the General Electric Co.'s machinery is used. The power station of the Electric Traction Co., using General Electric machinery, is described and illustrated in the "St. Ry. Jour." for June

St. Louis.—A very long and profusely illustrated article on the electric railways in St. Louis is published in the "St. Ry. Jour." for June.

Niagara Falls Park and River Railroad.—A brief illustrated description is published in the "Elec. Age," June 8.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Lighting of Small Towns and Villages.—Referring to the article abstracted in the Digest last week Mr. Sowter in the Lond. "Elec. Rev.," May 31, states that the idea of combining the management of a number of small stations in cities neighboring a large one, might be advisable if the distance is more than five miles from the central one, but within that radius he thinks it a far better plan to adopt the alternating-current high-tension system with about 5,000 volts; he thinks it is not likely that such serious accidents would occur as would entirely suspend the supply for any of the outlying towns for any length of time; he believes that a small continuous supply station with a man and a boy in charge would be quite as liable to break down; there are in use to-day high-tension mains which have been at work for years without the least trouble or fault; he does not see why an attendant would be necessary at the sub-stations.

Rules and Regulations.—The Lond. "Elec.," May 31, reprints in full the new set of rules and regulations proposed by the Board of Trade; they are reprinted in a way to show the difference between these and those at present in use; they do not admit of being abstracted; there are quite a number of changes.

The proposed rules for Australasia are briefly summarized in the same journal.

Pressure Curves.—Some additional curves and comments on those mentioned in the Digest last week are published in the Lond. "Elec.," May 31; a pair of curves is given, one representing the voltage of the positive side and the other that of the negative, the form being very irregular due to the fact that most of the motor load carried by that station is on the positive section.

Brussels.—An illustrated description of this continuous-current station is published in "L'Ind. Elec.," May 25.

Cheltenham.—A short illustrated description of this alternating-current plant is published in the Lond. "Elec. Rev.," May 31.

Lightning Arresters and Why They Sometimes Fail.—A lecture by Mr. Wurtz on this subject is reprinted in the "Jour. Frank. Inst." for June. He describes his well-known system of non-arc lightning arresters used in conjunction with choking coils. The chief reasons why lightning arresters sometimes fail to protect, he states, are the lack of insulation of the apparatus, a lack of a sufficient number of arresters and because they are often not properly installed; the defective insulation results either from weak insulating material or a faulty application of it, the latter being the chief cause, as the material used is generally good; faulty application may be due to improper design or carelessness or ignorance, of which he gives examples; he also points out the importance of a proper margin of safety, but notwithstanding this, deteriora-

tion may occur, chiefly from moisture or overheating; he shows that the well-known selective property of discharges often explain why arresters sometimes fail; if absolute protection is to be provided by spark-gaps the insulation strength must bear such relation to the spark-gap as to place it beyond the limit of selection; a liberal distribution of line arresters offers the only practical means of protecting widely distributed apparatus. In conclusion he gives a number of examples of carelessly installed lightning arresters some of which are amusing. An abstract of the portion explaining why arresters fail is published in the "St. Ry. Gaz.," June 8; a short abstract is published in "Elec. Ind." for June.

Electrical Fires in Chicago.—The "Electrical Jour.," June 1, contains a short article by Prof. Barret in which he gives a list of the fires of electrical origin in Chicago in 1894, the total losses of which amounted to less than $8,000. He believes that the greatest danger in electrical installations lies in the close and ruinous competition of bidders on the work; of these 61 fires a large percentage were due to either defective or injured wire; he believes there is no reason why ordinary installations should increase the fire hazard; in conclusion he adds some suggestions among which he states that wood of any description is not safe for the bases of instruments on which live portions of the circuits are mounted directly; a few illustrations of burnt out apparatus are given.

Coal Consumption at an Edison Station.—The "Elec. Eng.," June 12, abstracts very briefly a recent paper by Mr. Hale read before the Boston Society of Civil Engineers, on "Approximate Analysis of the Use of Coal in an Edison Electric Light Station of the Type Standard About 1890." He finds that the coal used in a 1,000-kw station, whenever it is completely ready to run, is equal to 500 pounds per hour plus 7.5 pounds per kw hour; a brief analysis is given of the constant loss of 500 pounds per hour. Some curves are reproduced showing the load diagram and the effect of connecting several stations together and by this means supplying the light day load from one common station; the stations referred to are those in Boston.

Accumulators in Central Stations.—The paper by Mr. Howell, abstracted in the Digest last week, is being reprinted in the "Elec. Rev.," beginning with June 12.

WIRES, WIRING AND CONDUITS.

Induction in Armored Cables.—In an article by Prof. Guye in "L'Eclairage Elec.," May 18, he gives the results of experimental demonstrations of the method of calculation which he described in a preceding article (see Digest, Nov. 17, 1894); the experiments were made with the concentric high-tension armored cables which were installed for the Geneva electric lighting plant. In the first series of experiments the inner conductor was used as the lead and the surrounding one as the return; the fall of voltage was found to be practically the same for continuous and alternating currents. In the second series only the central conductor was utilized, the other being disconnected and left on open circuit, the whole cable forming a loop; the loss of voltage was more than twice as great with alternating as with continuous currents and during the experiment it was not possible to send any telephonic messages in the city on account of the induction from these currents. The third series was like the second, only that the ends of the other conductor were connected together through an alternating current amperemeter and the two circuits therefore acted as they do in a transformer; the loss of voltage in the primary was greater than with continuous currents but the difference was less than in the preceding series. He concludes that figures obtained have satisfactorily demonstrated the correctness of the theory.

ELECTRO-PHYSICS AND MAGNETISM.

Unipolar Induction.—The paper of Mr. Lecher which was abstracted in the Digest, Feb. 2, is noticed in the Lond. "Proc. Phys. Soc." for June, where it is followed by an explanation by the abstractor, in which he states that those experiments "can probably be completely explained by treating the rotating magnetic 'charges' at the poles of the magnets as magnetic convection-currents, exactly similar to the electric convection-currents studied by Prof. Rowland. If the motion of these 'charges' is steady (whether rectilinear, circular, or of any other type, provided that at any fixed point in space the magnetic force is constant), the magnetic field is exactly the same as if the charges were at rest, and in addition there will be an electric field which possesses a potential at all points where there is no magnetic 'matter' in motion. This potential is, however, many-valued (just like the magnetic potential due to an electric current) if there is any magnetic convection-current passing through the curve of integration."

Conduction of Hot Gases.—A paper by Mr. Pringsheim from the "Sitz. Akad. Wiss., Berlin," 1895, p. 331, is abstracted briefly in the Lond. "Proc. Phys. Soc." for June; it shows that with one to ten dry cells, hydrogen, carbonic acid and air begin to conduct at a red heat, the conductivity increasing rapidly with the temperature and with diminishing pressure; the electrodes show a marked polarization, the highest observed being 0.5 volts.

Action of Electric Discharge on Lead Oxide.—A paper by Mr. Warburg from the "Wied. Ann.," 54, p. 727, is abstracted briefly in the Lond. "Proc. Phys. Soc." for June; lead oxide in a tube containing air at 2.5 mm pressure turns into peroxide of lead when a discharge is sent through the tube, the gas being absorbed; in hydrogen it is changed to metallic lead; the effect appears to be due to the light radiated from the glowing gas making the oxide more ready to react with the gas, and not to a chemical change in the gas which makes it more active.

Potential in a Conducting Liquid Having a Uniform Motion.—A brief abstract of the paper of Mr. de Villemontee, mentioned in the Digest, Feb. 9, is given in the "Jour. Inst. Elec. Eng." for May; he concluded from his experiments that the uniform motion of a conducting liquid through glass tubes of large diameter and of equal section throughout their length, produces no appreciable alteration in the differences of potential between two points in the liquid within the limits employed in the above case.

Conductivity of Salts and Acids in Aqueous Solution.—A paper by Mr. Franke from the "Zeit. Phys. Chem.," 16, p. 463, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Experiments on Electrical Dispersion.—A paper by Mr. Drude from the "Wied. Ann.," 54, p. 352, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Multiple Resonance.—A paper by Mr. Bjerknes from the "Wied. Ann.," 54, p. 58, is reprinted in "L'Eclairage Elec.," May 18; he gives in a general way the theory of multiple resonance.

Effect of Temperature on the Discharge of a Conductor into Air.—A paper by Mr. Oberbeck is abstracted in the Lond. "Proc. Phys. Soc." for June.

Energy Movements in the Medium Separating Electrified or Gravitating Particles.—Prof. Allen's paper (see Digest, April 20), is published in full in the Lond. "Proc. Phys. Soc." for June.

Gradient of Potential.—The recent article by Mr. Herz in the "Wied. Ann.," 54, p. 244, on the determination of gradient of potential on the positive part of the luminous discharge, is published in "L'Eclairage Elec.," May 18.

Dispersion and Dielectric Constants.—A paper by Mr. Paschen from the "Wied. Ann.," 54, p. 668, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Electrostatic Capacity of Coils.—A translation of Mr. Cauro's paper (see Digest, March 23), is given in abstract in the "Jour. Inst. Elec. Eng." for May.

Energy Transformations in Electrical Conduction.—The paper by Prof. Strecker abstracted in the Digest last week under "Conductivity" is abstracted in the Lond. "Proc. Phys. Soc." for June.

Atmospheric Electricity.—Prof. Schuster's paper is concluded in the Lond. "Elec.," May 31.

Earth Currents.—An abstract of Mr. Palmieri's paper (see Digest, May 11), is published in the "Jour. Inst. Elec. Eng." for May. This abstract is reprinted in full in the "Elec. Rev." (N. Y.), June 12.

Kation or Kathion.—In a communication in the Lond. "Elec.," May 31, Prof. Waddell questions the recent statement of Mr. Portheim (see Digest, April 6), in favor of "kathion" and expresses the belief that the Greek word on which Mr. Portheim bases his argument does not exist.

The E. M. F. of Alloys.—The Lond. "Elec. Rev.," May 31, calls attention to a paper by Mr. Laurie in the "Jour. Chem. Soc." for December, in which he gives results of determinations of the E. M. F. of 16 of the 19 alloys referred to by Mr. Matthiesson, confirming the latter's conclusions.

Resistance Variations of Bismuth.—A description of the investigations of Mr. Sadovsky in regard to the changes which occur in the electrical resistance of a bismuth wire in a magnetic field and carrying a current, is given in the Lond. "Proc. Phys. Soc." for June.

Earth's Magnetism.—A paper on "Lines of Equal Disturbance in the Magnetic Potential of the Earth for 1880," by Mr. von Bezold from the "Sitz. Akad. Wiss., Berlin," 1895, p. 363, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Pull of Magnets.—An abstract of Mr. Jones' paper in the "Wied. Ann.," 54, p. 641, is given in the Lond. "Proc. Phys. Soc." for June; he gives an experimental proof of the correctness of the law of the normal magnetic stress; it appears to be similar to the one abstracted in the Digest, March 23.

Experiments with the Electric Discharge.—The article mentioned in the Digest, June 15, is being reprinted with the illustrations in "El'ty," beginning with the issue of June 12.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemical Experiments.—In the "Elektrochem. Zeit." for June Mr. Zsigmondy describes a number of striking lecture experiments all of which can be produced with small apparatus. Several show the effect of current density on the nature of the electrolytic deposit, for which purpose he finds that copper and copper sulphate are the best materials to use, the latter being about two thirds saturated; a number of the experiments refer to arborescent deposits, in connection with which he calculates the current density from the speed of the growth of the arborescent deposit; for tin, in which he obtained a growth at the rate of 10 mm per second, he finds that the current density was 1,176,000 amperes per square decimeter. To produce a single crystal he suggests placing the negative terminal in the form of a wire, in a glass tube open at the bottom, the other electrode being in the liquid outside of the tube, the crystal will then grow out toward the end of the tube; for such experiments he finds tin the best material, using the chloride as the electrolyte; a detached crystal lying in the path of the current will be dissolved at one end and will grow at the other, therefore appearing to travel. To show the currents produced by two different liquids and a single metal connecting them, he cuts a round disc of tin leaving a long thin strip attached to it which is bent around so that the end

comes near to but does not touch the centre of the disc; it is then suspended horizontally so that the strip and point are immersed in the denser liquid while the disc is in the lighter liquid, which is carefully introduced so as not to mix with the other; for the former he uses a warm concentrated solution of chloride of tin and for the latter concentrated hydrochloric acid; crystals will then be formed on the point and the disc will be dissolved.

Bleaching Oils and Fats.—The Lond. "Elec. Rev.," May 31, describes the following system: a tank is divided into two parts by means of a porous partition, one containing a solution of common salt at eight degrees Twaddell strength and a carbon electrode, the other containing a mixture of the oil or fat with a similar solution and a copper electrode, the oil solution being agitated mechanically while the current passes; no further information is given.

Electrolysis of Chloride of Sodium.—According to a paper by Mr. Cassel, abstracted in the "Elektrochem. Zeit." for June, he states that the use of mercury as a cathode is a theoretically correct one and gives the results of tests with a plant containing 30 cells producing daily 1,200 pounds of sodium hydrate and 1,000 pounds of chlorine, with a 110-hp engine, proving that under favorable circumstances almost 90 per cent. of the theoretical product per watt can be obtained.

Electrolysis of Fused Salts.—Mr. Andreoli's serial is continued in "L'Elec.," June 1; in continuing his historical summary, he gives illustrated descriptions of several forms of apparatus.

Electrolytic Preparation of Natural Dyes.—A second article on this subject by Dr. Foelsing is contained in the "Elektrochem. Zeit." for June.

Disinfection by the Hermite Process.—A translation of Mr Farman's paper (see Digest, March 30), is given in abstract in the "Jour. Inst. Elec. Eng." for May.

Laws Regarding Dilute Solutions.—A paper by Mr. Wildermann in the "Zeit. f. Phys. Chem.," 1894, p. 337, is briefly abstracted in the Lond. "Elec. Rev.," May 31; he discusses the experimental proof of the well-known laws of Van't Hoff, Arrhenius and Ostwald on the dissociations in dilute solutions.

Theory of the Transition Battery Without Metastable Phase.—A paper by Messrs. Van't Hoff, Cohen and Bredig from the "Zeit. Phys. Chem.," 16, p. 453, is abstracted with some of the data, in the Lond. "Proc. Phys. Soc." for June.

Multivolt Battery.—In the "Elec. Eng.," June 12, Prof. Carhart shows that the principle of this battery, which has recently been described in all the journals, is not correct, and that the claim that there is no local action, no polarization and no heat "is mere buncombe and has no foundation in fact." In the same issue Mr. Johonnot endeavors to prove why the battery "works without wasteful local action"; he claims that there will be two equal and opposite E. M. Fs. generated in the openings in the carbons by the tendency to local action and that therefore there will be no current through these openings. (There is no question that his argument is incorrect and even absurd; there will certainly be much more local action than if separate retaining cells were used.)

Chlorine and Soda.—The "Jour. Frank. Inst." for June abstracts a brief description from "Genie Civil" of the apparatus recently installed in Birmingham, England, for the electrolysis of salt. The tanks are divided into three compartments, having mercury at the bottom which circulates between the compartments; the daily production is 1,300 pounds of soda and 1,100 pounds of liquid chlorine.

Cyanide Process of Extracting Gold.—The "Eng. & Min. Jour.," June 8, contains a communication and several short articles on this subject.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Standard.—The recommendations of the Photometric Standards Committee concerning a standard source of light, and embodying the results of three years' investigation, are briefly summarized in the Lond. "Elec.," May 31; it is believed that the recommendation which they make regarding the standard source of light "may be confidently accepted as giving the best solution at present possible of this much-discussed problem." They recommend the adoption of a 10-candle standard produced by some form of flame; only a portion of the luminous surface of the flame is utilized, as in the Methven standard; the gas used is reduced to a constant luminiforous power by passing it over the surface of liquid pentane as in the Vernon Harcourt standard; the height of the flame is adjusted to a fixed mark although slight variations are not important; the form of the instrument adopted is the 10-candle pentane Argand burner designed by Mr. Dibdin in 1886; the committee have satisfied themselves that these burners can be reproduced in any quantities with sufficient agreement among themselves and that the standard is equal to ten times that which has been legally recognized for the last 35 years. The claims of an electrical standard of light have been considered and found wanting. No further information is given.

Measurement of a Varying Temperature.—A Physical Society paper by Mr. Burstall is abstracted briefly in the Lond. "Elec." and "Elec. Rev.," May 31. He describes experiments made to determine the temperature inside of a cylinder of a gas engine at different points of the stroke of the piston; a modified form of platinum thermometer is used, the wire being very thin and unprotected owing to the rapid variations in temperature; the resistance was measured by a Wheatstone bridge; the galvanometer circuit was closed when an explosion took place, by means of a relay worked by the pointer of the steam engine indicator attached to the cylinder.

Determination of the Resistance of a Diaphragm.—A method is described by Dr. Krueger in the "Electrochem. Zeit." for June; the resistance of the liquid is first measured between two fixed electrodes, after which the diaphragm is introduced between them and the increase in resistance is that of the diaphragm; a number of results are given; the method was that of Kohlrausch, with a telephone and a bridge. He believes that this is a good method to determine the porosity of porous cells; the resistance of the diaphragm is proportional to the specific resistance of the electrolytes.

Capacity Tests.—A paper by M. Heinke from the "Wied. Ann.," 54, p. 577, is abstracted in the Lond. "Proc. Phys. Soc." for June; he points out a third source of error in measuring the capacity of condensers with alternating currents, which depends on the particular method of testing and connecting with the bridge; the other two well-known sources of error being the frequency of alternations and the extent of these variations in different dielectrics.

Submarine Cable Works.—In Mr. Wilkinson's serial in the Lond. "Elec.," May 31, he describes Kennelly's break test. The descriptions in this serial do not admit of being abstracted; it appears to be a good practical summary concerning submarine cable testing and may be recommended to those interested in the subject; it will not be referred to again in these columns.

Resistance of New Alloys.—The principal data from the recent article of Mr. Van Aubel (see Digest, April 27), is given in the "Jour. Inst. Elec. Eng." for May.

Idiostatic Electrometer.—A brief description of the Righi instrument, mentioned in the Digest, March 23, is given in the "Jour. Inst. Elec. Eng." for May.

Simple Form of Harmonic Analyzer.—Mr. Yule's paper is published in full with illustrations in "Proc. Phys. Soc." for June (see Digest, Apirl 20).

MacEvoy Explorer.—The instrument mentioned several times before in these columns, which was said to have been used successfully in locating the sunken Russian steamer, is described and illustrated in "L'Eclairage Elec.," May 18; it appears to be simply a practical application of the well-known Hughes induction balance.

Apparatus.—A well-illustrated description of some of the exhibits at the annual exhibition of the French Physical Society, are published in "L'Eclairage Elec.," May 18.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction in Single Wire Telephone Circuits Due to Railway Circuits.—In a paper by Mr. Pierard in the "Bul. d'Ass. Ing. El. Montefiore," Vol. 5, No. 6, he discusses the various methods used to avoid the noise in telephones due to induction from railway circuits and describes the one which is used with complete success in Brussells and Liege. He states that the introduction of self-induction coils is not a success and the same is true of the use of a common low resistance return conductor; for neutralizing the effect perfectly, exactly the same electrical factors must exist on the outgoing and the return wire. In the system described there is a common return wire, but the call is so arranged that the earth is automatically substituted for the return conductor during the calling signal; if absolute secrecy is necessary the earthed return may be used in place of the common conductor, but the line will then be subject to the interference of railway circuits.

Lalande Microphone.—An illustrated description is published in "L'Ind. Elec.," May 25. In the ordinary microphone the diaphragm when once disturbed will continue to vibrate, due to its own elasticity, and these vibrations will become mingled with those subsequently produced by the current, thus interfering with them; in order to avoid this, the vibration of the carbons is dampened, by connecting pieces of hard rubber to them, the ends of which dip into mercury placed in the bottom of the cylindrical space between the diaphragm and the back of the microphone, the mercury being also in contact with the diaphragm, and it therefore dampens these parasitic vibrations of both the membrane and the carbons; the clearness and the power of the instrument are said to be remarkable, and there is claimed to be no resonance when connected with even the longest circuits.

Telephony in Germany.—Some large tables of statistics for the year 1894 are published and discussed editorially in the "Elec. Zeit.," May 30.

Municipal Telephony.—A long editorial in the Lond. "Elec. Eng.," June 12, gives a brief review of the recent discussion in England regarding municipal telephony.

MISCELLANEOUS.

Carbide of Calcium—According to the "Zeit. f. Beleucht," May 30, the Neuhausen Aluminium Company, states that as a result of recent improvements it can now sell the compound in lots of at least one ton at 40 pfg. per kg which is equivalent to about $90 per short ton.

Royal Society Transactions.—According to the Lond. "Elec.," May 31, an index has recently been published of the Philosophical Transactions of the Royal Society covering the period from 1800 to 1895 and it appears that each paper may be bought separately.

New Journal.—From the first number of this journal, which has just been received, it appears that Prof. Barret is the president of the com-

pany, that the editors are Profs. Carhart, B. F. Thomas, Herdman, D. C. Jackson and Dr. Hornsby. It is to be semi-monthly. In an editorial announcement it is stated that there is a large class of people who are "practically debarred from a knowledge of electrical principles and laws, owing to the deeply scientific and mathematical character of existing text books and current literature"; it is the aim of that journal to keep this class thoroughly posted and to present items for their information and entertainment; subjects are to be treated in a clear, concise, every-day language comprehensive to the ordinary newspaper readers; all important editorials are to be signed by their authors; a portion of the journal is devoted to the National School of Electricity.

Electricity in Medicine.—In an article by Dr. Herdman in the "Electrical Jour.," June 1, he describes the different applications of electricity in medicine.

Therapeutic Action of High Frequency Currents.—The translated abstract of the recent paper (see Digest, May 11), by Messrs. Apostoli and Berlioz, mentioned last week, is reprinted in the "Elec. Rev.," June 12.

A Franklin Document—The "Elec. Eng.," June 12, reproduces a facsimile of a letter of Benjamin Franklin written Aug. 12, 1779, suggesting methods to try if the shock received from the torpedo fish is an electrical one.

Exhaust Steam Heating.

BY I. H. BABCOCK.

The rapid development of electrical industries has involved the construction of many steam power stations of great capacity. The best these stations can do is to utilize about 10 per cent. of the steam generated in creating the required power. The 90 per cent. which escapes through the exhaust pipe represents, to a very large extent, fuel, labor, the wear and tear of apparatus, and cost of management. Several of the more enterprising electrical companies have adopted economical methods whereby this waste product is turned to practical account. They have constructed underground mains for the distribution and sale of their exhaust steam for the heating of all kinds of buildings. This undertaking has proved to be unequivocally successful. One of the latest to adopt the new method is the Terre Haute (Ind.) Electric Railway Company, Russell B. Harrison, president. It has already had constructed by the American District Steam Company, of Lockport, N. Y., about one mile of mains leading from its boiler station, and is negotiating for the construction of two miles more of mains to be ready for the commencement of the heating season in October. The Terre Haute company also does the city and commercial lighting, and thus has a continuous supply of exhaust steam from boilers of 120-hp capacity.

The Danville (Ill.) Electric Light & Street Railway Company has also commenced the construction of an extensive system of underground steam mains, and will be selling its exhaust steam for heating as soon as the heating season opens. About the only expense of this added branch of the business is the construction of the steam mains, as these companies already have their boiler stations and other apparatus ready for use.

Brake Efficiency.

A speaker at a recent meeting of the English Institution of Electrical Engineers spoke unfavorably of braking engine tests. Referring to the engine under discussion, he said he had never had single-acting enclosed engines on the brake and knew nothing at all about their efficiency, but that much was heard about the common or garden engines running into fabulous efficiencies, 91, 92 and 94 per cent., and he certainly could not believe any figures of that kind unless he was given means of verifying the statements made. They knew there was nothing that would lie more consistently than an indicator, except, of course, a voltmeter or an ammeter. It was also known that it was very possible to get wrong indications in the brake. There was great trouble and scandal some years ago about the question of brakes, and it was shown then that the brakes were all wrong and all the results got from them were wrong. He would tell them one thing that made him sceptical about those high efficiencies. He saw a small engine braking 30 or 40 horse-power running empty, just turning round in steam, warm; it was running pretty freely, because three men, big powerful men, separately took hold of the fly wheel and shoved it round to see what they could do. One of them by superior strength or skill after he had let the wheel go, got three revolutions out of her, so there was not much wrong with that engine so far as friction went. It was about as free from friction as they could get an engine, but that engine on careful braking and indicating could only just get a bare 90 per cent. He had once seen a small fraction more, but only once.

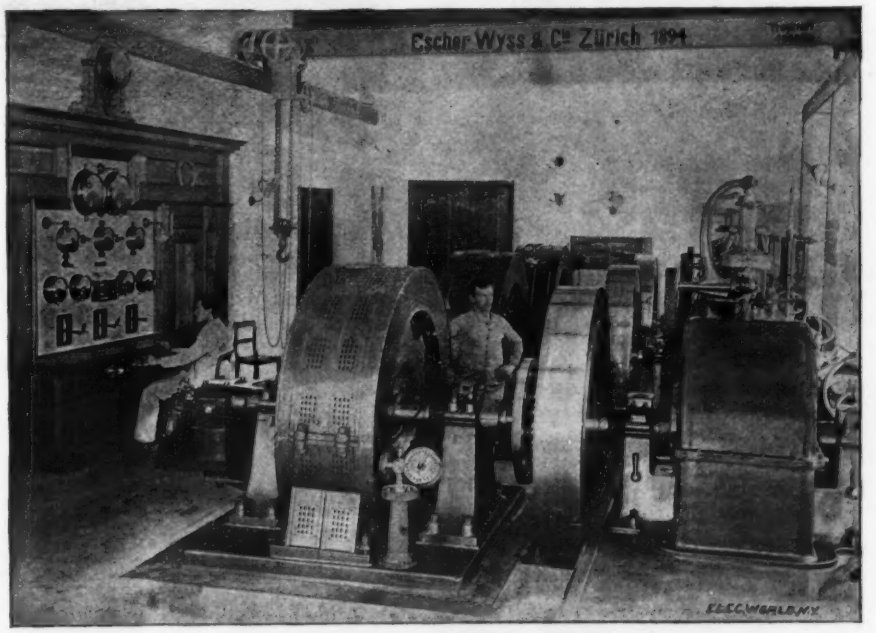
High-Speed vs. Slow-Speed Engines.

It is probable, says the London *Electrical Review*, that the bulk of American electrical driving engines are of the small variety of slide valve or Corliss engines. Americans have laid themselves out to produce small economical engines of these types, and they are run at very fairly high speeds. English engine builders have neglected the type, and large engines have not been employed simply because the division of units has been found desirable, and electrical stations are all so very small as yet. There must be something like 800,000 or 1,000,000 horse power in slow-running engines in the spinning branch of the cotton trade alone, so that the frantic cry for the builders of these engines to come forward and say something in their favor may well be received with a smile by the slow-speed men, who, if tackled on the question, would probably tell us that they did not have the same faith in the continuance of the infantile condition of electricity as was held by the supposed best friends of the electrical industry.

A New Swiss Central Station.

A water power central station has recently been installed by the Maschinenfabrik Oerlikon, at Davos, Switzerland, a view of the generator room of which we print herewith. The water is led to the turbines by a pipe about 6,560 feet long. The turbines, which are directly coupled to the dynamos, work under a head of 328 feet, and are provided with automatic regulators to govern the supply by means of hydraulic apparatus.

On the turbine shaft is mounted a fly wheel, which smooths out slight irregularities in the speed. In order to avoid variations in the pressure, which would undoubtedly occur with the long pipe line, an air pressure chamber is connected with the latter.



INTERIOR OF SWISS STATION.

Each turbine is provided with an apparatus for running at no load, which goes into operation automatically as soon as the opening of the supply pipe is closed.

The dynamos, of which there are three, are direct-driven by the corresponding turbines, and operate at a normal speed of 400 revolutions; at a normal potential of 3,360 volts they deliver 40 amperes, equivalent to about 200 hp. The number of periods is 53.

The individual machines can be easily switched in parallel, when they supply the common long-distance transmission line, which is about two miles in length. The transmission line consists of four wires, two 7 mm, and two 2½ mm in diameter. The latter serve to control the potential at the distributing points by making it possible for the engineer to maintain a definite potential at all loads. At full load, the line shows a loss (drop) of 1½ volts.

There are 18 transformers in operation of which seven are of 20 kw, four of 15 kw, two of 10 kw, three of 8 kw, and two of 6 kw. The transformers work normally at 110 volts, with the exception of the three of 8 kw, which serve for arc lighting.

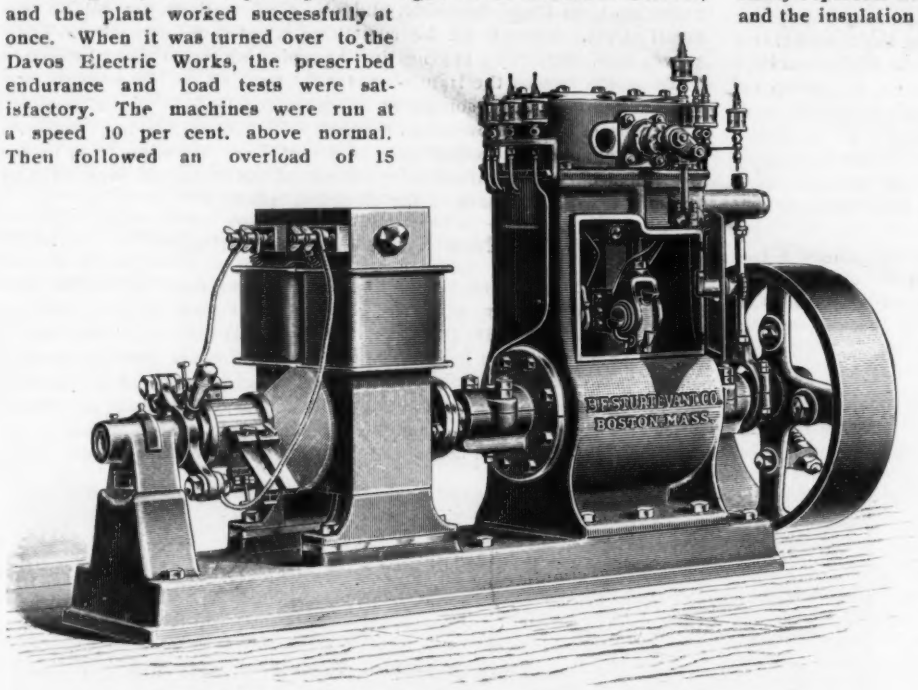
These transformers are placed in specially constructed boxes, out of doors. Each box contains, beside the transformer, a plate with the distributing conductors and their safety fuses so that each box holds all the apparatus necessary for cutting out the transformer on the primary as well as on the secondary side.

The public lighting is done with 30 arc lamps at 15 amperes. The lamps are arranged in three sets of 10 each, each set being supplied by a special transformer of 8 kw. As the lamps operate at about 35 volts, the transformers had to be wound for a potential of 400 volts.

The number of incandescent lamps, which increases from day to day, amounts to about 4,800 of 16 cp each.

The whole plant was built in about six months, from the beginning of May to the middle of October, 1894; but lighting could be done as early as September, though operation had to be stopped during the day time.

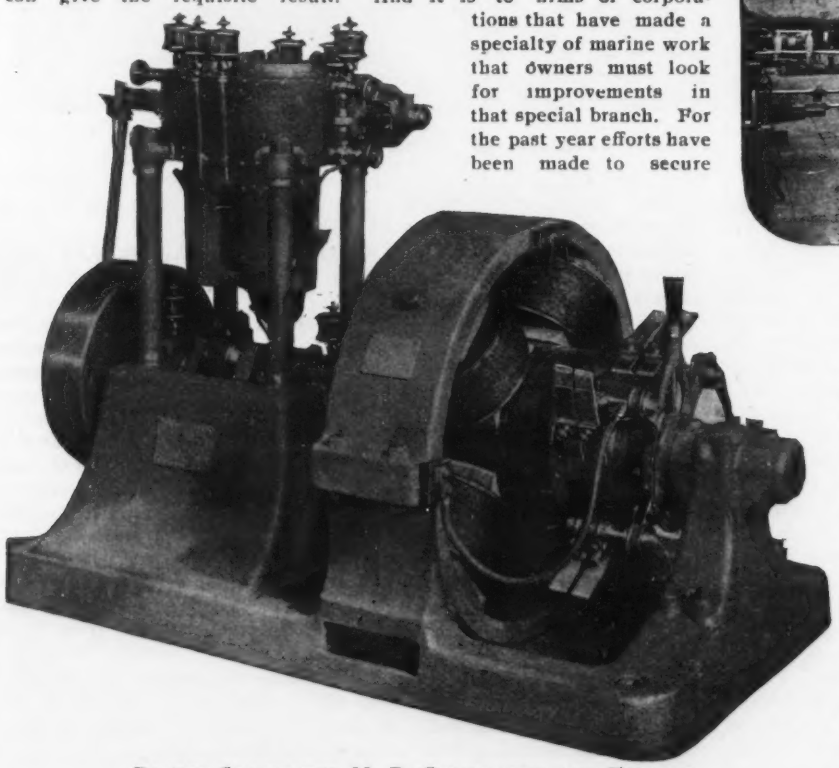
The regular, uninterrupted operation began in the middle of October, and the plant worked successfully at once. When it was turned over to the Davos Electric Works, the prescribed endurance and load tests were satisfactory. The machines were run at a speed 10 per cent. above normal. Then followed an overload of 15 per cent. for several hours. The fluctuations in the voltage, with sudden changes in the load up to 10 per cent., were observed, and, finally, every machine was subjected to a run of 24 hours under normal conditions.



Direct-Connected Bipolar Dynamo and Engine.

Marine Lighting Set.

The peculiar requirements which govern the installation of electric lighting and power plants on shipboard are such that only familiarity with the conditions to be fulfilled and long experience can give the requisite result. And it is to firms or corporations that have made a specialty of marine work that owners must look for improvements in that special branch. For the past year efforts have been made to secure greater compactness in the generator plant, and the latest type which is now being built by the General Electric Company is shown in the accompanying engraving.



Direct-Connected M. P. Generator and Engine.

The combination here illustrated consists of a double-cylinder vertical engine, 4¼ x 4, direct-coupled to an 8-kw multipolar generator. In the generator, which is of the latest type, all the material of the frame is available for magnetic purposes, so that the magnetic leakage is reduced to a minimum—a point of vital importance on shipboard. The frame is of soft cast steel of very high magnetic permeability, and the armature is iron-clad; the windings are interchangeable and can be easily replaced. Provision is made to ventilate the armature thoroughly, and the insulation throughout is unusually substantial. The commutator and brushes work perfectly under all conditions of load, and the regulation has been brought to a high degree of excellence.

This generating set occupies an exceedingly small floor space, which feature constitutes a strong point with shipbuilders and owners.

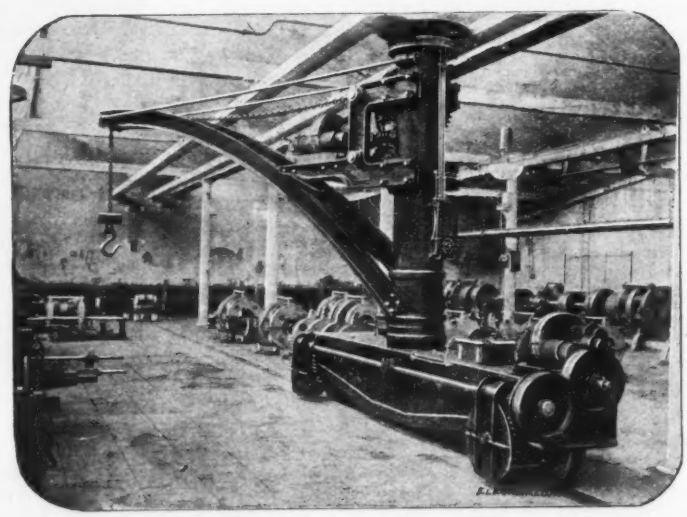
A Compact Lighting Equipment.

The direct-connected outfit illustrated herewith is notable for its small floor space and symmetrical appearance. The output of the combination is 3½ kw at 800 revolutions per minute; the floor space is 48 by 15 inches. The dynamo is the Adams' forged iron field magnet type with smooth-core armature, and is extremely light and compact, its weight, ready to mount on the extended engine base, being 450 pounds; these qualities especially adapt it for direct connection.

The engine is the well-known Sturtevant automatic, which has found general favor for direct connection to dynamos because of its high speed and close regulation.

A French Electrical Crane.

The electrical crane which we illustrate has recently been installed in the large electrical factory of its designer, Fabius Henrion, at Nancy, France. The travel of the crane is 240 feet, and as the reach is 15 feet its use extends over a floor space of 30 by 240 feet. The crane lifts six tons and takes castings at one end of the building, transports them successively to the scales, the various machine tools, to the fitting, testing and painting departments, and, finally, to a car for shipment.



Six-Ton Electric Crane.

The crane is guided at the base by a single rail and on top by two rails with a roller between them. Under the two upper rails are two conductors from which current is taken by a sliding trolley. A dynamo placed on the base furnishes power to move the crane along the track and is governed by a regulator, which can be seen in the illustration to one side of the dynamo. By turning the lever to the right or to the left the crane is given a forward or backward motion and faster or slower according as the lever is moved through a greater or less angle. The dynamo is reversed by reversing the armature connections. Carbon brushes are used which require no adjustment, whatever the load or direction of motion may be. The hoisting dynamo is on the strut which joins the column to the arm of the crane, and its motion is governed by means of the regulator seen fixed on the column. In lowering away, the descent cannot become too rapid for the reason that as the speed increases the dynamo becomes a generator and acts as a brake.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK June 15, 1895.

AMERICAN BELL opened a little weak on Monday, but rallied to 203½ on Wednesday and continued strong throughout the week. The change was probably due solely to Wednesday's announcement of a regular dividend of 3 per cent., and an extra one of 1½ per cent. The directors of the Bell Company voted, on Wednesday, to call a stockholders' meeting on June 24 to act on a recommendation to issue $1,000,000 additional stock. The outstanding capital is now $20,500,000. The new stock must be offered to shareholders at a price to be fixed by the commissioner of corporations, and any unsubscribed balance must be sold by auction. A prominent officer of the Bell Telephone says the company may again sell new stock at auction, but the last sale was very unsatisfactory and debenture bonds may be issued instead. The money is needed for extensions by sub-companies in which the parent Bell Company is a partner, and for which it has to pay its proportion. The revival of business will help the company materially. Its reduction in rates to sub-companies does not really decrease the revenue, as the sub-companies, because of the lower charges, will pay larger dividends to the parent compay. He thinks the stock should sell around 200 paying 12 per cent., and expects it to sell around 250. Taking the Bell Company and all its sub-companies, probably not over 7 per cent. per annum has been earned in the telephone business on all the money invested.

ELECTRICAL STOCKS.	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	31	31½
General Electric	100	36	36¼
General Electric, pref	100	..	65
Westinghouse Consolidated, com	50	36	36⅛
" " pref	50	53	53⅛
BONDS.			
Edison Electric Ill., New York	100	105⅛	105⅛
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	204	204¾
American District Telegraph	100	30	40
American Telegraph & Cable	100	94½	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	58	58½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	74	74¼
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	93	93⅛
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	20⅞	21⅛
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11½	14
" " pref.	100	..	53
Buffalo St. Ry	100	79	83
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	75¼	75¾
Hestonville	100	..	60½
Long Island Traction	100	11	11⅛
Louisville St. Ry. com	100	37	39
" " " pref.	100	87	88
New Orleans Traction	100	20	22½
" pref.	100	69	71½
North Shore Traction	100	23	28
" " pref.	100	78	81
People's Traction $30 pd	25	62¼	62⅜
‡Philadelphia Traction	50	82⅛	82⅞
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	72½	72⅞
" pref	100	..	92
Worcester Traction	100	13	16
" " pref	100	83	87
BONDS			
Buffalo St. Ry. 1st con. 5s	100	104	106
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

* With accrued interest.
† Ex-Div.
‡ Ex-rights.

WESTINGHOUSE remained steady around 34 until the report was circulated yesterday regarding the Manhattan Elevated, when the stock went to 36. As the report was generally discredited by conservative people it is difficult to see how any effect on the stock could result, but there was nothing else to account for the sudden jump. The report was promptly denied, to day, by all parties concerned, but the fact that there has been considerable actual conference between Colonel Hain, of the Manhattan, and the Westinghouse people gives strength to the belief that the Westinghouse Company will eventually equip the elevated roads, notwithstanding the fact that no contract has as yet been effected.

ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 149 subscribers in May. Total number connected June 1, 16,756.

EDISON ILLUMINATING, Brooklyn, reports net earnings for May, 1895, of $13,687; ditto, 1894, $12,475; increase, $1.212

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, June 17, 1895.

MR. J. A. VAN ETTEN, manager of the Edison Electric Light & Power Company, Little Rock, Ark., was a visitor in New York last week. Mr. Van Etten speaks encouragingly of business prospects in the West.

MR. WILLARD W. LOW, president of the Electric Appliance Company, Chicago, was in the city for a few days last week. Mr. Low reports that his company is doing a very satisfactory business and is well pleased with the outlook.

G. S. PARKER, for many years connected with the Electric Supply & Construction Company and of late with R. B. Corey, has severed this connection and associated himself with Chas. E. Bramhall, 39 Cortlandt Street, New York, sales agent for the Standard Thermometer Company, of Peabody, Mass.

ELECTRICAL WORKERS' UNION NO. 34 has elected P. F. Healey, of Brooklyn, president; John Holehan, recording secretary, and S. J. Whalen, financial secretary. John Ryan has been elected president of Electrical Workers' Union No. 36; the secretary is A. H. Moses, and J. P. Casey has been elected financial secretary.

NEW STATION EQUIPMENT.—The Steinway Electric Railway Company recently installed a 500-kw G. E. multipolar generator direct-connected to a Dixson Corliss tandem-compound engine, and the combination was started up on last Friday. The engine and generator ran smoothly from the start, and up to last accounts had continued in service with entire satisfaction.

CHARLES E. GREGORY, president of the Charles E. Gregory Company, Chicago, was a visitor in New York last week. Mr. Gregory enjoys a national reputation as a progressive, energetic business man. Being thoroughly posted on the merits of electrical apparatus and always on the lookout for new acquisitions, his stock can be relied upon to contain everything from a fan motor to the largest dynamo and at advantageous prices. His present eastern trip means the addition of several car loads to his already large stock.

TROLLEY SPEED IN BROOKLYN.—President Lewis, of the Brooklyn Heights Trolley road, President Partridge, of the DeKalb Avenue road, and Vice-President Illersley, of the Atlantic Avenue road, had a conference with Mayor Schieren last week in reference to the speed of the trolley cars. They spoke in favor of increasing the present rate of speed and complained of the reduction in receipts since the six-miles-an-hour ordinance went into effect. Mayor Schieren intimated that some change in the ordinance would meet with his approval.

WRAY BILL SIGNED.—Governor Morton has signed the Wray bill, providing that municipal officers authorized by law to contract for street lighting may contract for a period not exceeding 15 years for city lighting. Such contracts are to be subject to competition and shall secure to such city prices lower than any now prescribed by law with a progressive reduction in price for each year during the performance of such contract. The corporation may supply light to citizens by contract over a period of years at prices lower than those charged heretofore and progressively lower for each year of such term of contract.

THE WESTON COMPANY EXPANDING.—The Weston Electrical Instrument Company has outgrown its Newark quarters and has arranged for an extensive plant at Waverley, N. J. The company has purchased about 48 acres of land on both sides of Frelinghuysen Avenue for the purpose. Twenty-three acres will be opened up in building plots for employees of the works, and the property will be rented or sold upon easy payments to the employees. About 100 cottages will be built upon this tract by the company. Prof. Weston has other things in view besides the manufacture of his direct-reading voltmeters and ammeters, and will begin upon a new line of work as soon as the details of the present line of manufacture are completed and the new plant is in perfect operation.

ELECTRICAL MATTERS IN BROOKLYN.—At the meeting of the Brooklyn Board of Aldermen last week the regular weekly effort to give to the State

Electric Light & Power Company permission to erect poles and string wires in Kent Avenue and other streets of the eastern district was made and thwarted by a combination of Republicans and Democrats. The board adopted a resolution directing the city works commissioner to enter into contracts for street lighting with the electric light companies. The prices were given in this column last week. On motion of Alderman Roeder the time in which the Kings County Electric Light Company shall begin work on its conduits was extended four months. This is the scheme of which Charles Cooper, once a conspicuous figure in the old electric companies, is the chief pusher.

English Notes.

(From Our Own Correspondent.)

London, June 5, 1895.

STANDARD OF LIGHT.—At the instance, mainly, of the London gas companies, a Photometric Standards Committee was appointed some time ago to investigate the question of a better standard of light than the parliamentary candle. The report of this committee has recently been published. It does not propose to alter the unit, namely the candle, but proposes to adopt as a *standard* a 10-candle pentane flame, only a portion of the luminous surface being used, as in the Methven standard.

A NEW SOURCE OF REVENUE FOR RIVERSIDE ELECTRIC SUPPLY STATIONS.—At a recent meeting of the Kingston Town Council a local firm of electrical engineers asked permission to run a main from their works to the riverside for the purpose of charging the accumulators of electric launches. This permission was promptly refused, and it was stated that it was the intention of the municipal supply station to do the job itself, a profitable revenue being anticipated from this source, since there was no other charging station near at hand.

TELEPHONE MANUFACTURE.—Owing to the lapse of the English patents the chief telephone manufacturing company of this country is suffering very severely from foreign, principally German, competition. Its dividend on the ordinary shares has now fallen to 1½ per cent. With a view to reducing the manufacturing cost it is proposing to remove its works from London. The manufactures of this company are of undoubted excellence and finish, but it is difficult for the non-technical public to discriminate between good and bad in the matter of telephones and to resist the temptation of buying rubbish at 10s. instead of good apparatus at double that sum.

ABSOLUTE MEASUREMENT OF ELECTRICAL RESISTANCE.—An interesting lecture was recently delivered at the Royal Institution by Prof. J. V. Viriam Jones, F. R. S., on "The Absolute Measurement of Electrical Resistance." The lecturer possesses an unusually fluent style which turned what might otherwise have been to a popular audience, a somewhat dry subject, into one of absorbing interest. Prof. Jones strongly advocated that the official standard of electrical resistance should be a specification in absolute measure rather than an actual piece of metallic wire; in other words, that this standard should be obtained directly by an electromagnetic method. He exhibited a model of the apparatus which he himself had used in his researches into this subject and stated that with the actual apparatus itself an error of less than one in 10,000 could easily be determined. As this error is the maximum permissible in our official standard of resistance there is strong grounds for Prof. Jones' claim that the absolute method is sufficient for practical purposes.

NEW BOARD OF TRADE RULES.—The Board of Trade has recently published and issued to central station engineers and others a revised set of rules and regulations relating to the safe working of electrical supply undertakings and have invited suggestions to be sent in by the end of the month. We are accustomed in this country to spend considerable money and trouble with a view to ensuring the safety of the public, nevertheless there is universal grumbling in connection with the new Board of Trade regulations, not that they contain anything particularly novel, but their issue has brought matters to a head. These rules will be discussed both by the electrical trade section of the London Chamber of Commerce and the Council of the Institution of Electrical Engineers, but it is to be hoped that the Board of Trade will do the same as they did in regard to their electric traction regulations, that is to say, call together a conference of the representatives of the interests concerned and discuss the regulations clause by clause across a table.

TELEPHONE SERVICE OF THE UNITED KINGDOM.—The Parliamentary Committee of Inquiry which has been sitting for some time past and investigating grievances and suggestions with regard to the telephone service of the United Kingdom, completed the hearing of evidence last week, and is now considering its report, which, if any attempt is made to digest and summarize the evidence and make specific recommendations based thereon, should certainly prove a lengthy and possibly a valuable document. The chief suggestion of any novelty which was made, was that of municipal telephony, but it cannot be said that its advocates cut a very fine figure, or brought forward the strongest arguments which might have been brought forward in its favor. Perhaps the net result of the inquiry will be to convince the telephoning public that the National Company is not quite so black as it has been painted; compared with other countries its charges are not so high, nor its service so bad as has been represented, and considering the way in which it has been hampered by the post-office in the matter of royalties and general restrictions and by the local authorities themselves in the matter of way-leaves, it is not far short of a miracle that the telephone exchange system has managed to survive.

THE LONDON COUNTY COUNCIL AND TRANSFORMER SUB-STATIONS.—Notwithstanding the ruling of the Board of Trade that the existence of transformer sub-stations under the pavements was *not* a grave public danger, as was alleged by the London County Council and the other local authorities of London, several of the local authorities, headed by the London County Council itself, continue to hamper the operations of electric light companies engaged in the distribution of current on the alternate-current transformer sub station system. The latest fight is between the London County Council and the House-to-House Company which is anxious to construct transformer sub-stations of the inside dimensions of 5 by 6 feet 6 inches by 7 feet deep, and which has been forbidden to do so by the London County Council. The company contends that as it has received the provisional permission of the Board of Trade it may legally proceed with the construction of these sub-stations. An appeal has, I believe, been made to the Board of Trade and it will be interesting to see whether the Board of Trade goes back upon its decision of a few months ago and decides at the instance of the London County Council that transformer sub-stations of large dimensions *are* a public danger. The same authority is hampering the operations of the County of London and Brush Provincial Companies which has some 76 transformer sub-stations in contemplation.

CENTRAL STATION ENGINE PRACTICE.—The discussion on Mr. Mark Robinson's paper on recent developments of the single-acting high-speed central station engine came to a conclusion on Thursday evening last; the Institution of Electrical Engineers then adjourning until the autumn. The debate was one of the best we have had this session, being confined to practical men with strong views. The discussion resolved itself into a duel between the advocates of double-acting and single-acting high-speed engines; the numerous gentlemen who are so ready to air their advocacy of the slow-speed horizontal engine in the columns of the engineering journals, not apparently caring to come out into the open and discuss the matter before a competent assembly. A very excellent speech was made by a representative of one of our leading firms of high-speed, double-acting engines. He made a strong point by referring to the fact that the admiralty had had such an unfortunate experience of the Willans engine that they had eliminated it entirely from Her Majesty's ships. Further emphasis was given to this by the remarks of a naval engineer, who stated that so far as his experience went the great advantage of the Willans engine was the interchangeability of its parts. In his reply, however Mr. Robinson succeeded in somewhat diminishing the force of this indictment by stating several instances of the gross carelessness of naval engineers. He said that he was afraid that his firm had offended the admiralty by hinting to that august government department that the Willans engine was not an hydraulic but a steam engine; a large proportion of the breakdowns of Willans engines on Her Majesty's ships being due to the fact that water which had condensed in long unused steam pipes had been allowed to find its way into the cylinders.

General News.

New Incorporations.

THE ANTHRACITE TELEPHONE & SUPPLY COMPANY, has been incorporated at Shamokin, Pa., with a capital stock of $10,000.

THE SMITHVILLE WATER & LIGHT COMPANY, Smithville, Tex., capital stock $400,000, has been incorporated by K. H. McDonald and others.

THE HAMMOND LIGHTING COMPANY, Chicago, Ill., capital stock $210,000, has been incorporated by Wm. B. Engel, C. F. Griffin and M. E. Barnhart.

THE BIG FOUR ELECTRIC COMPANY, Chicago, Ill., capital stock $200,000, has been incorporated by Wm. H. Brown, Louis K. Gibson and Henry D. Ames.

THE TRUMANSBURG ELECTRIC LIGHT COMPANY, Trumansburg, N. Y., capital stock $10,000, has been incorporated by C. C. Sears, A. S. Mosher and others.

THE ADAMS & BAGNALL ELECTRIC COMPANY, Cleveland, O., has been incorporated to manufacture electrical apparatus, railway motors, incandescent lamps, etc.

THE MAMMOTH SPRINGS ELECTRIC LIGHT COMPANY, Mammoth Springs, Ark., capital stock $100,000, has been incorporated by H. G. Kings and others.

THE POPULAR TELEPHONE COMPANY, Watsonville, Cal., capital stock $25,000, has been incorporated by C. A. Rice, W. H. Lamb, Joseph Schwartz and others.

THE WOODWARD WATER, HEAT & POWER COMPANY, Woodward, Oklahoma, capital stock $25,000, has been incorporated by A. G. Cunningham and John M. Pugh.

THE DALLAS STREET RAILWAY COMPANY, Dallas, Tex., capital stock $500,000, has been incorporated by F. P. Clark, Baltimore; G. L. Blackwood, Denison, and J. L. Salle.

THE DALLAS CITY STREET RAILWAY COMPANY, Dallas, Tex., capital stock $500,000, has been incorporated by Frank P. Clark, of Baltimore, J. L. Sale, of Dallas, and others.

THE MOUNDSVILLE, BENWOOD & WHEELING RAILWAY COMPANY, Moundsville, W. Va., capital stock $250,000, has been incorporated by J. W. Burchinal, M. F. Cox, and others.

THE BLUE EARTH VALLEY TELEPHONE EXCHANGE COMPANY, Blue Earth, Minn., capital stock $50,000, has been incorporated by Washington Z. Haight, Andrew C. Dunn and others.

THE SHELBY ELECTRIC RAILWAY COMPANY, Shelby, O., capital stock $10,000, has been incorporated by S. S. Bloom, Albert Moore, G. D. Geilelen, C. S. Holbrook, F. A. Abbott and J. W. Williams.

THE FRANKLIN COMPANY, of Pittsburg, Pa., has been formed by H. W. Mitchell and Chas. F. Patterson, of Pittsburg, and Wm. H. Dodds, of Allegheny, Pa. The capital stock is reported to be $1,000.

THE MARIETTA ELECTRIC COMPANY, Marietta, Ga., capital stock $10,000, has been incorporated by D. N. Anderson, G. F. Gober, A. S. Clay and others to generate electricity for light, heat and power.

THE INDIANAPOLIS, ANDERSON & MARION RAILWAY COMPANY, Indianapolis, Ind., capital stock $500,000, has been incorporated by M. J. Clodfaller, of Crawfordsville, V. C. Quick, of Alexandria, and others.

THE HAMMOND & BLUE ISLAND RAILWAY COMPANY OF INDIANA, Chicago, capital stock $80,000, has been incorporated. The promoters are Edw. S. Whitney, Fred. B. Fuller, Jas. T. Maher and Ralph Martin.

THE HILLSBORO STREET RAILWAY COMPANY, Hillsboro, Tex., capital stock $15,000, has been formed to operate street railway in Hillsboro. R. J. Ware, H. W. Carter and C. E. Carter, all of Hillsboro, are interested.

THE NORTHERN ELECTRIC COMPANY, Norwalk, O., capital stock $25,000, has been formed to generate electricity. Geo. P. Jones, Parks Foster, Mayme C. Foster, Burton P. Foster and John W. Foster are the incorporators.

THE SPRINGER ELECTRIC COMPANY, McCordsville, Ind., has been incorporated by T. L. Springer, S. Morrison and A. C. Morrison, for the purpose of manufacturing electrical apparatus and operating telephone exchanges.

THE PENN ELECTRIC LIGHT, HEAT & POWER COMPANY, capital stock $100,000, has been formed to generate electricity for light, heat and power, by John P. Bechtel, Chas. N. Frame and Milton H. Schnader, Reading, Pa.

THE PLYMOUTH WATER, LIGHT & POWER COMPANY, Plymouth, Wis., capital stock $50,000, has been formed to build water, light and power works. H. E. Dow, A. W. Schram and H. Wheeler, Jr., Plymouth, are the organizers.

THE REXFORD-WHITMORE-ELDRED IMPROVEMENT COMPANY, Seattle, Wash., capital stock $6,000, has been formed to operate electric light plants, etc. The promoters are Louis A. Rexford, Jesse K. Whitmore and Elon Eldred.

THE SAN JOSE LIGHTING COMPANY, San Jose, Cal., capital stock $250,000, has been formed to generate electricity for light, heat and power, gas, etc. Chas. F. Wilcox, Jos. R. Patton and Wm. H. Sumner, of San Jose, are interested.

THE BRIDGTON & HARRISON ELECTRIC COMPANY, Bridgton, Me., capital stock $10,000, has been formed to generate electricity. Geo. P. Locke, Norway; Chas. E. Gleason and Chas. A. Scribner, Bridgton, are the promotors.

THE PEOPLE'S LIGHT, HEAT & POWER COMPANY, Denver, Col., capital stock $100,000, has been formed to construct an electric light company. The promoters are Wm. H. Brevoort, Chas. F. Lacombe and Samuel S. Campbell.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY, Jersey City and New York, has been formed by Warner Van Norden, William de la M. Van Norden, New York; H. T. Bronson, Rye, and Edward C. Boardman, Garden City, N. Y.

THE GLOBE ELECTRICAL COMPANY has been incorporated at Detroit, Mich., with a capital stock of $10,000, to manufacture and sell dynamos, motors, etc. The promotors are Will H. Palmer, Scott H. Morris and Friend Palmer, Detroit, Mich.

THE GEAUGA COUNTY TELEPHONE & ELECTRIC COMPANY, Huntsburg Centre, O., capital stock $2,000, has been incorporated by Geo. W. Pease and others to build and operate a telephone line from Huntsburg Centre to Chardon.

THE SUBURBAN ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $1,250,000, has been formed to operate a railway. Geo. I. Talbot, Jas. W. Kenney, Oscar L. McMurray, Homer K. Galpin and J. S. McClashen are the promoters.

THE AUTOMATIC CIRCUIT BREAKER COMPANY, Newaygo, Mich., capital stock $10,000, has been formed to manufacture and sell electrical machinery, etc. The organizersare Chas. C. Kritzer, A. C. Runnels and Nancy Runnels, Newaygo, Mich.

THE SOUTH SHORE STREET RAILWAY COMPANY, of Erie, Pa, capital stock $100,000, has been organized by L. J. Chase, Buffalo, N. Y., and Frank McLaughlin and E. M. Ketcham, of North East, to build an electric railway in North East.

THE GROSS STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock $6,000, has been formed to build an electric street railway. W. B. Rhodes and Joshua Rhodes, of Allegheny, and W. H. Latshaw, of Pittsburg, are the interested parties.

THE LEADVILLE ELECTRIC POWER & IRRIGATION COMPANY, Denver, Col., capital stock $500 000, has been formed to erect and operate an electric plant. John H. Poole, Roswell E. Rodell and Edward W. Rollins, Denver, Col., are interested.

THE HUMBOLT MANUFACTURING COMPANY, Arcata, Cal., capital stock $15,000, has been formed to generate electricity, build flour and feed mills, etc. C. A. Callstorm, J. Cullberg, Jr., Wm. Chaffey and J. M. Moore, of Arcata, are interested parties.

THE NEGLEY STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock $6,000, has been formed to build an electric street railway. W. B. Rhodes and Joshua Rhodes, of Allegheny, and Wm. H. Latshaw, of Pittsburg, are the interested parties.

THE CHATHAM ELECTRIC LIGHT, HEAT & POWER COMPANY, Chatham, N. Y., has been organized to manufacture and use electricity by H. M. Francis and J. O. Carr, of Schenectady, and J. F. Farrell, of Albany. The capital stock is $10,000.

THE WILLIAMSBRIDGE GAS & ELECTRIC LIGHT COMPANY, Williamsbridge, N. Y., capital stock $30,000, has been formed to manufacture gas, and to generate electricity. C. H. Royce, W. S. Johnson and Franklyn Paddock, New York, are interested.

THE ALLEGHENY POWER COMPANY, Pittsburg, Pa., capital stock $1,000, has been formed to supply light, heat and power by means of electricity. H. W. Mitchell, Pittsburg; Wm. H. Dodds, Allegheny, and Chas. F. Patterson, Allegheny, are interested.

THE FREEMANSBURG ELECTRIC COMPANY, Freemansburg, N. Y., capital stock $10,000, has been formed to manufacture and use electricity. The promoters are C. C. Sears, J. H. Smith, O. C. Noble, all of Freemansburg, and C. S. Wixom, Covert, N. Y.

THE CARTHAGE ELECTRIC TELEPHONE COMPANY, Carthage, Mo., capital stock $5,000, has been formed to erect and maintain telephone lines. The promoters are Theo. J. Clark, E. C. Clark, Geo. W. Wheeler and E. R. Wheeler, Carthage, Mo.

THE MILWAUKEE ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., capital stock $8,000, has been incorporated by J. E. McKivitt, M. W. Weisser and J. C. Schmitt for the purpose of manufacturing and dealing in electrical supplies and machinery.

THE CANALES TROLLEY COMPANY has been incorporated at Springfield, Ill. Capital stock $100,000; to own, manufacture, buy and operate inventions relating to trolleys and machinery. The promoters are Adam M. Ross, Frank W. Canales and T. Henry Pearse.

THE FLORIDA RAILWAY, HEAT, LIGHT & POWER COMPANY, Sanford, Fla., capital stock $400,000, incorporated by J. M. Saunders, A. Meuser and others, has received a franchise to construct an electric line in Sanford and between that town and Longwood.

THE SEA BEACH CONSTRUCTION COMPANY, capital stock $100,000, has been formed to construct and equip electric street railways. The promoters are John W. Bowles, New York; T. Bridgewater Jones, Staten Island, N. Y., and J. Herbert Potts, Jersey City, N. J.

THE LANCASTER WATER, LIGHT & ICE COMPANY has been incorporated at Lancaster, Tex., by R. P. Henry, S. L. Randlett, W. A. Strain, F. M. Hammond, W. L. White, and others, to supply water and electric lights and manufacture ice Capital stock $15,000.

THE GREENVILLE LIGHT COMPANY, Greenville, O., capital stock $5,000, has been formed to manufacture and supply light, heat and electricity for public and private use. Mr. John P. Martin, Chas. Darlington, E. M. Milton and M. A. Broadstone, of Xenia, O., are interested.

THE LITTLE FALLS STREET RAILWAY, Little Falls, N. Y., has been incorporated with a capital stock of $75,000, to build and operate an electric surface road. The organizers are W. H. Tylee, Worcester, Mass.; C. L. B. Tylee, J. L. Miller and F. H. Vrele, of Corning, N. Y.

THE WEST END ELECTRIC LIGHT & POWER COMPANY has been incorporated at West Hazleton, Pa., with a capital stock of $10,000, to supply light, heat and power. The promoters are Thos. H. Powell, of Hazleton; Walter McAvoy and Wilson S. Betterly, West Hazleton, Pa.

THE BATESVILLE & OLDENBURG RAILWAY & ELECTRIC COMPANY, Batesville, Ind., capital stock $50,000, has been incorporated. Kendal M. Hord, Bellamy S. Sitton, Ed. K. Adams and Jonas Joseph, Shelbyville, and John Hilderbrand, Batesville, Ind., are the interested parties.

THE CITIZENS' TELEPHONE COMPANY, Indianapolis, Ind., has been incorporated with $15,000 capital stock, by Andrew E. Reynolds, and Carl L. Rost, of Crawfordsville, and George W. Caldwell, of Columbus, for operating telephone lines in Marion, Bartholomew, Jackson and Johnson counties.

THE MISSOURI GAS COMPANY has been incorporated at Kansas City, Mo., with a $1,500,000 capital stock to supply gas, electric light, heat and power. The promoters are Irwin Reu and Henry C. Reu, Chicago, Ill.; C. J. White, J. C. James, J. M. Lowe and Robert M. Snyder, of Kansas City, Mo.

THE CRESCENT SILVER PLATE COMPANY, Chicago, Ill., capital stock $10,000, has been formed to do a general carriage, harness and hardware business; also to do plating, and manufacture electric and gas fixtures. The promoters are Walter J Mullen, Wm. K. Ziegfeld and Barnet Rubenstein.

THE NEW YORK & PHILADELPHIA TELEGRAPH & TELEPHONE COMPANY, capital stock $15,000, has been incorporated by E. P. Meaney, Newark, N. J.; M. Egleston, Elizabeth, N. J., and A. E. Holcombe, of New York, to erect telegraph and telephone wires from New York to Philadelphia.

THE TOPEKA TELEPHONE & ELECTRICAL COMPANY, Topeka, Kan., capital stock $100,000, has been formed to construct and maintain telephone lines and exchanges; deal in electrical goods, etc. A. K. Rodgers, S. J. Bear, Simeon Greenspan and A. P. Jetmore Topeka, Kan., are interested.

THE PRESSLEY SINGLE TRACK ELECTRIC RAILWAY COMPANY, San Francisco, Cal., capital stock $500,000, has been formed to purchase, use and sell patents for electromagnetic safety railways, etc. L. C. Pressley, J. C. Rhoads, J. O. Jephson, C. S. Wheaton and W. P. Oecling are interested.

THE BATTLE MOUNTAIN HEAT, LIGHT & POWER COMPANY, Victor, Col., capital stock $500,000, has been formed to manufacture and supply gas and to generate electricity for lighting purposes in that town. Jas. F. Burns, Jas. Doyle, R. M. Reardon and J. B. Cunningham, Victor, Col., are the interested parties.

THE GLOBE TELEPHONE COMPANY, of New York, has been incorporated in West Virginia with a minimum capital stock of $50,000, to buy, sell and lease patents, operate telephone lines, etc. The promoters are Geo. W. Williams, Portland, Ore.; Frank B. Carpenter, Chas. L. George and Ed. Bradley, New York City.

TELEGRAPH AND TELEPHONE.

STATESVILLE, N. C.—E. C. Hein has obtained a franchise for a telephone exchange.

ELLSWORTH, KAN.—The Pohlman Electric Light Company is putting up telephones.

NORFOLK, VA.—The Southern Electric Service Company is petitionin for a franchise to construct underground conduits for a telephone system, etc.

HARTFORD, WIS.—The Badger State Telephone Company, of Hartford, will construct a line from Neosha to Woodland and Iron Ridge and other points.

MIDDLETOWN, N. Y.—The Orange County Telephone Company is asking the Common Council for permission to erect poles and string wires through the streets within the city limits.

ELECTRIC LIGHT AND POWER.

LEXINGTON, MO —On June 18 Lexington will vote for electric lights.

MADRID, IA.—The citizens have voted to issue bonds for a water and light plant.

BALTIMORE, MD.—A second-hand ¼-hp motor is wanted at 427 Hanover Street.

SUMMERVILLE, S. C.—F. W. Wagner can be addressed regarding an electric light plant.

ALFRED, N. Y.—Steps are being taken looking to the establishment of an electric light plant.

LANARK, ILL.—A franchise has been granted H. Reid Staley to put in an electric light plant.

SAGINAW, MICH.—The Board of Public Works favors the placing of the wires underground.

CULLMAN, ALA.—The mayor will give information concerning the erection of an electric light plant.

DAWSON, GA.—The City Council has authorized an issuance of $10,000 bonds for an electric light plant.

REYNOLDS, GA.— G. Goodwin is interested in the construction of the proposed electric light plant.

ASHLEY, ILL.—The citizens of Ashley are figuring on an electric light plant to be owned and operated by the city.

LANSINGBURGH, N. Y.—George Gramm, village clerk, is inviting proposals for lighting the village by electricity.

WESTPORT, MO.—The mayor can give information concerning the erection of a lighting plant, either by gas or electricity.

MILFORD, MICH.—The Milford Electric Light Company will add a 100 hp boiler and 75-hp engine and desires prices on same.

SHIPPENSBURG PA.—The Electric Light, Heat & Power Company is in the market for two 30-kw direct-current 110-volt dynamos.

ROCKWELL CITY, IA.—An electric light company will probably ask for a franchise to put in an electric light plant at this place.

ELBERTON, GA.—Steps are being taken to organize a company to develop an electrical power plant. Calhoun Falls will probably be utilized.

SMITHLAND, KY.—A movement is in progress to erect water works and electric light plant. A company is being organized for the purpose.

LEXINGTON, KY.—The City of Lexington will receive bids until June 26 for furnishing street lights, and will also consider bids for electric lighting plant.

JOHNSTOWN, PA.—The Johnstown Telephone Company is making arrangements to extend its line to South Fork, Ebensburg, Wilmore and other nearby towns.

LEXINGTON, KY.—K. T. Duncan is inviting bids until June 26 for lighting the streets with gas or electricity, or both, on a five or 10-year contract after Oct. 31, 1895.

MILES CITY, MONT.—Bonds are to be issued to purchase an electric light plant and waterworks that supplies the town and which is now owned by a private corporation.

SANTIAGO, CAL.—An electrical expert is figuring on the establishment for a plant to supply the city with electric power, which is to be secured from the waterfall on the Flume Line.

PHILADELPHIA, PA.—The Southern Electric Light & Power Company will erect an extensive power house at Gray's Ferry Road and Carpenter streets. Cost with machinery, $150,000.

BOSTON, MASS.—A six-story block to be erected at the corner of Elliott and Pleasant streets will be equipped with electric elevators. Architect Patrick A. Tracy is in charge of the work.

RAHWAY, N. J.—It will necessitate an outlay of over $10,000 by the Electric Light & Power Company to provide its plant with additional machinery required for lighting the streets.

ALTOONA, PA.—Proposals will be received by the Edison Electric Illuminating Company, of Altoona, Pa., up to 12 o'clock noon, July 1, 1895, for a new steam plant, steel stack and trestle.

MANHEIM, PA.—The Borough Council has voted to grant the Manheim Electric Light, Heat & Power Company rights and privileges to erect poles and string wires on the streets of the borough.

DENVER, COL.—The County Commissioners have decided to advertise for bids for the electric light plant at the County Hospital. Plans and specifications are on file at Room 3, County Court House.

JAMESTOWN, N. D.—John A. Masters has purchased the controlling stock in the Jamestown Electric Light Company and is now president and general manager. The company is in the market for a 35-hp engine.

EL PASO, TEX.—Sealed proposals will be received until Aug. 2 for lighting the streets of El Paso by electricity for a term of five years, from Sept. 1, 1895, not less than 50 lights to be furnished, and all lights to be of not less than 1,200 candle-power. B. F. Campbell is mayor, and W. T. Kitchens city clerk.

PETOSKY, MICH.—The Furniture City Electric Company, of Grand Rapids, Mich., has secured the contract for equipping the new Imperial Hotel at Petosky, for lights and bells, also the Macatawa Park Hotel and grounds at Macatawa Park, near Holland, Mich., for complete electric light plant and bells.

HOBOKEN, N. J.—Proposals and bids will be received by the Board of Freeholders of the County of Hudson, at 4 p. m., June 20, for the furnishing and erection of 183 combination gas and electric light fixtures for the new lunatic asylum at Snake Hill. Plans and specifications can be seen at office of the board, next to Court House, or at office of Architect H. Kreitler, 55 Montgomery Street, Jersey City.

The Electric Railway.

JACKSON, MICH.—The street car line is to be extended to Vandercook's Lake at a cost of $35,000.

GRAND HAVEN, MICH.—The new street railway is being rapidly pushed toward completion.

SKOWHEGAN, ME.—An electric road will be constructed between Skowhegan and Madison.

CHARLESTON, S. C.—Mr. Hoefgen is president of the Brooklyn syndicate which is to build a new electric road here.

GAINESVILLE, GA.—D. R. Evans and others are organizing a company to build an electric line in the city and suburbs.

CARTERSVILLE, MO.—The Fitch Electric Railway Company has received permission to build an electric road in this city.

PALM BEACH, FLA.—A company is to be organized to build an electric road along the east bank of Lake Worth to Palm Beach.

LITTLE ROCK, ARK.—J. H. Healey and others have asked for a franchise to construct an electric line along several of the city streets.

DALLAS, TEX.—It is announced that the Dallas & Oak Cliff Railway has completed arrangements to extend its road to Fort Worth.

WESTPORT, MO.—The Westport Council has granted a franchise to the Kansas City Electric Railway, giving it also the right to furnish heat and motive power.

PHILADELPHIA, PA.—The Council sub-committee on street railways has decided to postpone further consideration of the Cayuga Street railway trolley extension.

AUSTIN, TEX.—The Dam Boulevard Railway Company has secured permission to erect its poles and wires. It will secure water power from the Colorado River dam.

LITTLE ROCK, ARK.—W. S. McKain, P. W. Crawford and E. W. Milball are interested in the Boulevard Street Railway, which will be about three and one half miles long.

BAY CITY, MICH.—The Common Council has received a petition from the Inter-Urban Street Railway Company asking for a franchise to construct and operate a street railway.

TROY, N. Y.—Application has been made for permission to change the motive power on the White line branch of the Troy City Railway, between Cohoes, Green Island and Troy, to electricity.

CLAREMONT JUNCTION, N. H.—Steps are being taken looking to the establishment of an electric line of cars from Claremont Junction through West Claremont to Newport and Sunapee Lake.

WARREN, PA.—The North Trumbull Rapid Transit Company will construct a passenger and freight electric railway from Farmdale to Mesopotamia, 20 miles. Said company was recently organized.

LOUISVILLE, KY.—A company is being formed to build an electric road 35 miles long, from Louisville to Fairfield, running through Jefferson County. John H. Ward and B. McKinney are interested.

HARTFORD CITY, IND.—The matter of building an electric railway nine miles long to connect Hartford City and Montpelier is being agitated. J. P. McGeath, of Hartford City, can give information.

SPENCER, MASS.—The Richmond Construction Company intends to commence work Aug. 1 on the new street railway from Spencer to Warren. The completion of the road is not expected until next spring.

LOCKPORT, N. Y.—President Charles A. Johnson, of the Lockport City Railway Company; F. H. Reed, W. T. Thiers and E. M. Ashley are interested in the construction of an extension of the electric road to Olcott.

NEWARK, N. J.—At a meeting of the Bloomfield township committee an ordinance passed its first reading calling for a double track electric road from the city line to the present terminus of the horse car road on Bloomfield Avenue.

CINCINNATI, O.—R. J. H. Archible, John Rempy and others are among the incorporators of a new company which is going to construct an electric line from the end of the Norwood or Hyde Park lines to the Oakley race tracks. The capital stock is $10,000.

NIAGARA FALLS, N. Y.—An application of the Niagara & Lewiston road for authority to increase its capital stock from $100,000 to $1,400,000 was granted. The company will build an electric line overhanging the bank of the Niagara River from Niagara Falls to Lewiston.

BALTIMORE, MD.—The Canton, Sparrows Point & North Point Company has commenced the grading of its electric line in Canton. The route is to terminate at North Point on Chesapeake Bay and is about 12 miles long. F. W. Wood and W. B. Brooks, Jr., are interested.

Personal Notes.

MR. FRANK LONEY PERRY, assistant business manager of the *Western Electrician*, will be married June 27, at Chicago, to Miss Lucretia Faulkner. Mr. Perry is widely known from his connection with the trade press, and in his matrimonial departure will carry with him the best wishes of the entire electrical fraternity.

HENRY C. PARMLY, senior member of the real estate firm of Parmly Brothers, Chicago, and a member of the Board of Directors of the Standard Electric Company from its inception, died on Thursday of last week. Mr. Parmly leaves a widow and a 10-year-old daughter, Grace, and a brother, S. P. Parmly. He was born in Painesville, O., in 1836 and educated in Ohio colleges. Though of a quiet, retiring disposition, yet he was a charming companion, a loyal friend, an upright, wholesome and progressive citizen.

Miscellaneous Notes.

THE WESTERN SOCIETY OF ENGINEERS will extend the courtesy of one of its rooms to Lehigh University on June 21, 22 and 23, in which to hold its local examinations for admission to the Freshman class. The examinations will be under the direction of Mr. H. F. J. Porter, western representative of the Bethlehem Iron Company.

THE "M. I. T." SOCIETY, OF NEW YORK, has been organized by those of the alumni and former students of the Massachusetts Institute of Technology, who live in and around New York City. At a recent meeting held for the purpose of effecting preliminary organization, Messrs. G. L. Heins, E. D. Brown, H. S. Chase and F. A. Pickernell were elected as the executive committee, and the committee on organization elected is composed of Messrs Chas. R. Richards, H. P. Barr, C. W. Eaton, E. H. Munford, F. A. Pickernell and A. Rice McKim the last-named gentleman being also elected secretary and treasurer. On account of the time taken up by business matters the paper on "Bracing of the Skeleton Type of High Buildings," which was to have been read by Mr. McKim, was held over until the next meeting.

Trade and Industrial Notes.

FRANK H. STEWART & CO., of Philadelphia, have removed their headquarters from 20 to 35 North Seventh Street.

LARGE GENERATOR CONTRACT.—The West End Railway, of Boston, has recently placed an order with the General Electric Company, covering two 800-kw, two 1,300-kw and one 1,500-kw generators, all for direct-connection to the engines.

AN INDEX OF PUMPS and pump accessories is a rather unique idea which the Goulds Manufacturing Company, of Seneca Falls, N. Y., has put in practice in the shape of a small pamphlet containing a full list, alphabetically arranged, of all its various products.

MR. H. H. HARRISON has become identified with the interests of Mr. R. B. Corey, and can hereafter be found at the office of the latter, 39 Cortlandt Street, New York, where he will be glad at all times to see his many friends and tell them all about arc lamps, carbons, etc.

A LARGE ENGINE CONTRACT has been placed by the Edison Electric Illuminating Company, of Paterson, N. J., with the Ball & Wood Company, 15 Cortlandt Street, New York. The equipment will consist of two 700-hp, five 600-hp and one 300-hp vertical engines of the latest Ball & Wood type.

AN AUBREY BEARDSLEY DAMSEL in the embrace of peacock feathers, with a rescuing Lundell fan motor approaching from the background, is the frontispiece of a recent circular of the Central Electric Company, Chicago. The remaining pages point out the many other uses of the fan motor, of which a half dozen types are illustrated.

JAMES WOLFF, 320 Dearborn Street, Chicago, the popular and energetic western representative of the New York Insulated Wire Company, has returned from a successful business trip. Mr. Wolff considers the business outlook in the Western and Middle States very bright, and reports a gratifying increase in this season's business over the same period last year.

WAGNER TRANSFORMERS AND FAN MOTORS IN DEMAND.—The Wagner Electric Manufacturing Company, of St. Louis, Mo., is now several weeks behind on orders for fan motors and is running full force in the transformer department on some large contracts recently secured. The company is well pleased with this season's business and considers the prospects for a large fall trade encouraging.

A NICE BUSINESS is reported by the Electric Appliance Company, Chicago, on Jaeger miniature lamps for which the company has just taken the general western agency. The Electric Appliance Company carries in stock a complete line of Jaeger goods, comprising mounted and unmounted series lamps, battery, dental and theatrical lamps, lamp bases, shades and holders, and is prepared to quote special figures on quantity orders.

THEATRE AND STAGE LIGHTING APPARATUS is the title of a handsome catalogue just issued by the Mayrhofer Electric Stage Lighting Company, 842 Broadway, New York. The extent to which electricity is now applied in the theatres may be realized by a glance through the pages of this pamphlet. Many forms of apparatus are illustrated, and a description given of some novel electrical stage effects that may thereby be produced.

AT THE ANNUAL MEETING of the stockholders of the Phœnix Carbon Manufacturing Company, of St. Louis, held last week, the following Board of Directors was elected for the ensuing year: S. M. Dodd, S. B. Pike, Thos. H. West, J. C. Van Blarcom and James Campbell. The new board met after its election and appointed S. M. Dodd, president; S. B. Pike, vice-president; H. L. Page, secretary and treasurer, and S. G. Booker, superintendent.

J. H. VAIL, 39 Cortlandt Street, New York, is prepared to act as consulting and supervising engineer for the installation of electric light and railway plants, electric transmission of power and all other engineering work. Mr. Vail has been engaged by the Wilkesbarre (Pa.) Electric Light Company for the construction of a large electric light and power plant for the utilization of the product of a valuable culm bank recently purchased by the company.

STRONG GUARANTEES are made by the Emerson Electric Manufacturing Company, of St. Louis, Mo., in its new catalogue of fan motors. The company assumes all responsibility for repairs not due to carelessness or accident which may become necessary within three months from date of sale of a motor. Two new motors have been brought out this year by the Emerson Company—a ceiling fan for alternating-current circuits and an induction desk fan motor which has neither commutator nor collector rings. These are made for 7,200 and 16,000 alternations. Instructions are given in this, as in previous catalogues, for the care of the Meston motors.

CHLORIDE OF SILVER DRY BATTERIES.—A handsome catalogue of electro-medical batteries has been issued by the Chloride of Silver Dry Cell Battery Company, of Baltimore, in which are described a number of physicians' outfits and accessories which have been brought to a high stage of development by the manufacturers. A special feature is the Willms rheostat, by the use of which the current strength may be regulated from maximum to minimum by imperceptible gradations. Another improvement consists in making the individual cells interchangeable, so that the owner can replace exhausted cells without having to send the entire battery to the factory.

NATURE MAY ABHOR A VACUUM, but the users of the Williames vacuum system of steam heating and the Webster feed water heaters seem to differ with her, judging from the rapidly increasing list of customers shown by Warren Webster & Co., Camden, N. J. Among the recent orders for Webster "vacuum" heaters and purifiers not previously mentioned are Philadelphia Construction Company, Philadelphia, 1,600 hp; Temple Electric Company, Temple, Tex., 150 hp; Wilkesbarre & Wyoming Valley Traction Company, Wilkesbarre, Pa., 1,200 hp; Kittanning Electric Light & Power Company, Kittanning, Pa., 250 hp; Freeland Electric Light & Power Company, Freeland, Pa., 320 hp.

TRIPLEX POWER PUMPS.—The following recent sales of triplex power pumps are reported by the Goulds Manufacturing Company, of Seneca Falls, N. Y.: Freydenburg Falls Paper Company, Plattsburg, N. Y., one 12 by 12 inch pressure pump to be used with grinders; Jay Paper Company, Jay, Me., one 7 by 8 inch pump to be used for pumping stuff; Lewiston Foundry & Machine Company, Lewiston, Pa., two 1¼ by 2 inch pump for boiler feeding; Tide Water Oil Company, Bayonne, N. J., three 4 by 6 inch pumps, two to be used for pumping oil and one for pumping water; one 1⅝ by 6 inch and one 2½ by 6 inch, to be used for pumping ammonia; Standard Oil Company, Olean, N. Y., two 8 by 12 inch pumps for water supply; P. H. Potter, Springfield, Mass., one 4 by 6 inch pump for boiler feeding; Worcester Engineering Company, Worcester, Mass., one 12 by 12 inch pump for water works system at Millbury, Mass.

THERE ARE BATTERIES AND BATTERIES, and the Law Battery Company, of 39 Cortlandt Street, New York, explains at length in an attractive new catalogue, the difference between the two classes. Two strong claims made for the Law battery are low internal resistance and high E. M. F. The negative element of the "double cylinder" type has about 145 square inches of surface and the jar holds two and one half pints of solution. Attention is called in the catalogue to the fact that in telephone work a battery which deteriorates rapidly is a nuisance, entailing frequent adjustments of the transmitter and other obvious annoyances. It is claimed that the Law battery gives a practically uniform current throughout its life, thus obviating the troubles mentioned. Four styles of batteries are described. A strong testimonial to the quality of the sal-ammoniac handled by the Law Company is presented in the shape of a certificate of analysis from a well-known chemist. The catalogue also describes medical outfits in which the Law battery is extensively used.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street, New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 11, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

540,620. ELECTRIC CIRCUIT; W. W. Alexander, Kansas City, Mo. App. filed March 24, 1890. The combination of a relay provided with contacts, armature, sounder and a switch and a signal controller and a battery for operating the mechanism.

540,641. RAILWAY SIGNAL; W. Daves, Jersey City, N. J. App. filed Dec. 29 1894; 540,642, filed Feb. 14, 1895. The combination of circuits arranged to be automatically cut out of circuit by the trains, running upon the tracks.

540,653. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; O. A. Enholm, New York, N. Y. App. filed Nov. 3, 1891. The combination of a main feeder and return rail, and distributing stations located at suitable points along the road with the make or break apparatus located therein.

540,664. ELECTRIC RAILWAY; S. Hoeninger, Milwaukee, Wis. App. filed Aug. 15, 1894. An electric railway having suspended yokes centrally provided with insulated hangers, spring controlled insulators pivoted thereto and a trolley wire joined to the pivotal insulators.

540,668. REGULATION OF ALTERNATING GENERATORS; R. M. Hunter, Philadelphia, Pa. App. filed June 21, 1894. The combination of a generator, line circuits, a separate continuous current leading to the field magnets of the generator and a regulating device arranged in the continuous circuit.

540,685. ELECTRIC BRAKE; W. B. Potter, Schenectady, N. Y. App filed March 9, 1895. In an electric braking apparatus a controlling switch, a reversing switch, a brake switch, interlocking mechanism between the switches, and means arranged to vary the effect of the interlock in accordance with the position of the reversing switch.

540,687. COVERING FOR ELECTRIC WIRES; F. S. Randall, Philadelphia, Pa. App. filed Jan. 2, 1894. A covering which consists of silver drawn longitudinally until the fibres have been rendered parallel, evenly applied parallel with the conductor.

540,691. APPARATUS FOR LINING TUBES; W. T. Ruete, New York, N. Y. App. filed Feb. 26, 1895. The combination of a supporting rod to rest a pipe which is to be lined, a carrying rod for conducting the strips into the tube and one or more guides for curving the said stripe before they enter the tube.

540,742. ILLUMINATED SIGN OR DISPLAY; P. F. Keelyn, Milwaukee, Wis. App filed Jan. 18, 1895. An illuminated sign consisting of a series of letters built up from elements thereof, each element comprising a separate incandescent electric lamp of exactly the same length as that of the other lamps, also having the same size filament, and connected to wires at each end.

540,761. TELEPHONE; W. W. Scott, Buffalo, N. Y. App. filed March 4, 1895. A voice conveyor comprising a tube with double walls having an elongated, confined, tortuous passage extending around the inner tube in a zigzag or spiral manner, one end of the said passage opening outwardly, and the other into the passage through the instrument.

540,772. PHOTO-TELEGRAPH; C. Willoughby, San Francisco, Cal. App. filed Nov. 3, 1894. The combination of a checked diagram or chart, numerals to

indicate the vertical columns, and letters to indicate the horizontal columns and additional characters and words to be used in combination with the column characters, to indicate the character of line to be drawn.

540,781. TELEPHONE TRANSMITTER; D. Drawbaugh, Eberly's Mill, Pa. App. filed Feb. 16, 1895; 540,959, filed Feb. 23, 1895. These two patents relate to transmitters having a body of carbon interposed between the electrodes and an elastic carbon holder having an opening of a size to fit the said electrodes and keep the carbon in operative position.

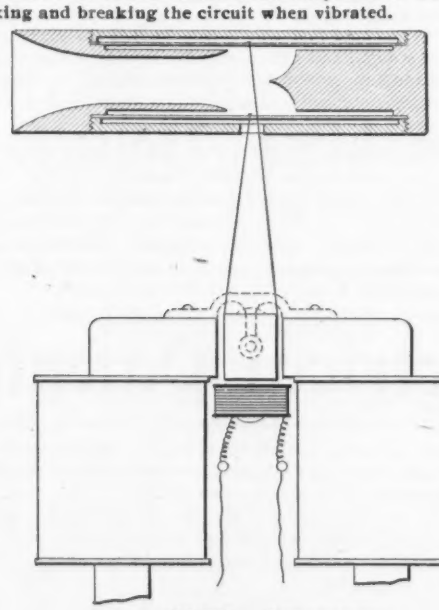
540,800. ELECTRIC ARC LAMP; S. P. Parmly, Chicago, Ill. App. filed Oct. 26, 1891. A pair of pencils adapted to be presented to one another end to end and to be adjusted toward one another as they are consumed by an arc passing between them, formed each with an elliptical or oval figure in cross-section.

No. 540,961.—Telephone Electrode.

540,859. ELECTRIC RAILWAY SIGNAL; B. H. Gedge, Anderson, Ind. App. filed May 20, 1892. The combination of lines or rails separated at desired intervals by forming divisions and there connected to an electromagnet, and other intervals between the said insulation, and another line of electric conductors separated near the electromagnets and capable of being put into circuit by the circuit closers, and locomotives provided with electric signal devices to complete the circuit between the conductors.

540,883. TROLLEY; W. E. Steinbach, Philadelphia, Pa. App. filed April 6, 1895. A trolley having transversely extending slots in the frame, roller adapted to engage the trolley wire, and sliding shafts carrying the rollers mounted in the said slots, and a movable arm adapted to bear against the shafts for separating the rollers.

540,899. TELEGRAPHIC APPARATUS; L. Boudet and P. Lacombe, Lumel, France. App. filed Oct. 20, 1894. The combination of a suitable dial, a plurality of hands carried by shafts concentric with one another, a toothed wheel secured to each of the shafts and a vibrating mechanism actuated by the rotation of the toothed wheel located adjacent to each of such wheels for making and breaking the circuit when vibrated.



No. 540,969.—Telephone.

540,900. CONDUIT ELECTRIC RAILWAY; D. Brooks, Jr., Philadelphia, Pa. App. filed June 9, 1892. The combination of a conduit, a sectional conductor and a continuous conductor with intervening insulating strips, upwardly projecting guards on the sides of the sectional conductor, a receiver having a chain adapted to contact with the sectional conductor.

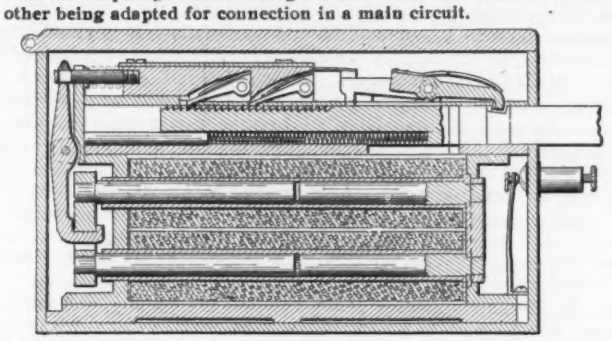
540,901. CONDUIT ELECTRIC CONDUCTOR; D. Brooks, Jr., Philadelphia, Pa. App. filed Feb. 27, 1892. A conductor formed of two conductors having an insulating material between them, one being continuous, and the other consisting of separated sections, both conductors being connected by fusible material.

540,949. ELECTRICAL PUSH BUTTON; E. A. Clark, Cleveland, O. App. filed Jan. 24, 1895. A push button formed of a casing having an inwardly projecting rim, a flaring metallic cap engaged by the rim, contact points held in the path of the cap, and a spring extending into the cap for automatically separating the cap from the contact points.

540,960. CARBON HOLDER FOR TELEPHONES; D. Drawbaugh, Eberly's Mill, Pa. App. filed Feb. 21, 1895. A carbon holder consisting of an annulus constructed wholly of sponge encircling the electrodes, and a body of granular carbon interposed between the electrodes and held in place by the annulus.

540,961. TELEPHONE ELECTRODE; D. Drawbaugh, Eberly's Mill, Pa. App. filed Feb. 21, 1895. A telephone electrode comprising two diaphragms, a disc-like annulus filling the space between the said diaphragms, carbon buttons carried by the diaphragms of a size to fit the opening in the annulus, and a body of granular carbons interposed between the said buttons.

540,969. TELEPHONE; S. D. Field, Stockbridge, Mass. App. filed Dec. 5, 1894. A telephone having two independent circuit windings in inductive relation to each other, one of said windings being in mechanical connection with the diaphragm and forming a closed circuit complete in itself, and the other being adapted for connection in a main circuit.



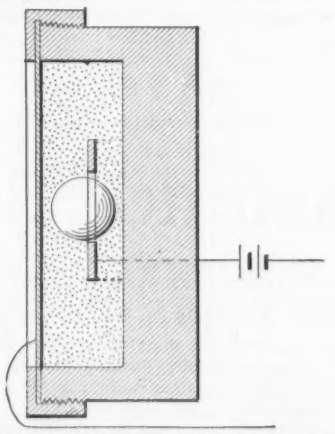
No. 541,024.—Electromagnetic Combination Lock.

540,974. MULTIPLEX TELEGRAPHY; D. B. Grandy, St. Louis, Mo. App. filed Dec. 17, 1894. The combination of a line, a single armature, a neutral relay having two mechanically separated electromagnets differentially wound and placed in different planes, resistance coils having iron cores and condensers, one of the said electromagnets being connected to the main line, and the other connected in shunt circuits with the said condensers around the said resistance coils.

541,019. ELECTRIC WIRE LOCK AND SUPPORT; D. W. Smith, St. Louis, Mo. App. filed Sept. 10, 1894. An improved wire loop comprising a body of material having a transverse recess at a point about midway of its length, and grooves formed in each side of it curved downward and together extending continuously from one end to the opposite end, and being overhung by a lug or projection.

541,020. CONDUIT ELECTRIC RAILWAY; D. W. Smith, St. Louis, Mo. App. filed Sept. 10, 1894. The combination of a loop formed integral with and in the length of the conductor at the crossings of the conduit, the loop comprising vertically bent portions, horizontally bent portions and a circular loop all bent from the length of the conductor.

541,024. ELECTROMAGNETIC COMBINATION LOCK; E. and H. C. Stockwell, Stamford, Conn. App. filed Aug. 6, 1894. The combination of suitable bolt-operating mechanism, two detents or dogs controlling the said mechanism, a time lock connected with one of the said detents for disengaging it, and an electrically operated lock connected with the other detent for disengaging it, whereby the bolt-operating mechanism cannot operate until both detents are disengaged.



No. 541,036.—Telephone Transmitter.

541,036. TELEPHONE TRANSMITTER; C. Clamond, Paris, France. App. filed March 20, 1895. The combination of a movable electrode and sound receiving diaphragm, an adjacent receptacle, having a bridge within it, a paste contained within the said receptacle and a loosely supported ball encompassed by said paste and maintained in relation to the movable electrode.

541,037. Filed March 20, 1895. This patent is substantially the same as the above one.

541,044. TROLLEY WHEEL AND YOKE; W. H. Fritz, Dayton, O. App. filed March 12, 1895. A trolley yoke consisting of a single piece and having journal openings extending approximately one half of each side from the centre to the circumference, bosses on the outer side and partially surrounding the journal openings, openings in the said bosses adapted to receive pins, and a trolley wheel, a shaft for said wheel having openings in its ends and adapted to be mounted in the journal openings in the yoke, and means for securing the said shaft therein.